3rd 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

In-depth study of electronic circuits

Introducing

Description

Electrical characteristics of diodes and transistors (MOSFETs, JFETs and bipolar transistors). Biasing circuits and corresponding amplifying classes. Models of active components and equivalent small-signal electrical schemes for LF and/or HF signal analysis. Main functions and associated circuitry (current generation, current mirrors, differential amplifiers, etc. ...). Amplifying, filtering and impedance adaptation. Implementation of models in an electrical circuit simulator.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts) :
- The electrical characteristics of diodes and transistors.
- The concept of static biasing and the principle of small signal behaviour around the bias point.
- The different amplification classes for transistors based circuits.
- The concepts of low and high frequency modelling in order to design advanced functional circuits.

The student will be able to:
- Design and realise a bias circuit which is well adapted to a given function.
- Extract the equivalent small signal scheme suited for low or high frequency signal analysis.
- Recognize and implement the basic circuitry such as differential amplification, current generators and mirrors.
- Know how to use an electrical circuit simulator and the suited models of active components as well as their limitations.
- Know how to build an amplifying and filtering chain with a view to integration.
- Conceive circuits especially adapted to sensors.
- Conceive a power amplifying stage taking into account the power dissipation.

Necessary prerequisites

Fundamentals of electricity, Kirchhoff's laws, Thévenin and Norton's and superposition theorems, voltage and current sources. Fourier's and Laplace's transforms.

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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Semiconductors

Introducing

Description

Part 1: Fundamentals of Materials Physics

Presentation of quantum mechanics concepts underlying the electronic structures of the atom.
Introduction to chemical bonding and the organization of matter.
Study of crystalline structures.
Understanding band diagrams to distinguish insulators, semiconductors, and metals, as well as the concept of density of states within a material.
Review of elementary statistical physics to explain how to modify charge densities in a semiconductor material through doping.

Part 2: Doping and PN Junction

Understanding different types of semiconductor doping.
Construction of a simple component like the PN junction, introducing band diagrams of these structures at thermodynamic equilibrium and non-equilibrium (under bias or illumination).
Study of charge carrier diffusion laws to establish the laws governing current levels observed in PN junctions under bias.

Part 3: Bipolar Transistors

Understanding the operation of the PN junction and its integration within a bipolar transistor.
Explanation of various physical properties of bipolar transistors, particularly their role as amplifiers.
Highlighting the links between the electronic properties of components and physical phenomena, such as the current gain parameters Alpha and Beta of bipolar transistors.

Part 4: CMOS Technologies

Emphasizing the physical links between materials and the electronic operation of MOS capacitors, MOS transistors, and their integration through CMOS technologies.
This course aims to provide students with the fundamental knowledge and practical skills necessary to understand and apply the principles of materials physics and components in information technologies.

Part 5: Practical Work

As part of our module on semiconductor materials and their characterization, you will have the opportunity to participate in 7 hours of practical work in a cleanroom at AIME. These sessions will allow you to implement the knowledge acquired in lectures and tutorials. During these practical sessions, students will construct and electrically characterize photovoltaic cells following the Lumelec procedure developed at AIME. For more details, the Lumelec manual for this practical work is available at the following link: https://www.aime-toulouse.fr/wp-content/uploads/2024/04/FasciculeLumelec_EN_2024-2.pdf

These practical sessions are an excellent opportunity to enhance your technical skills and understand the practical applications of the theoretical concepts covered in the course.

Objectives

This course introduces the physics of materials and components involved in technologies associated with the transmission, processing, and storage of information. It focuses on timeless fundamental

principles in a rapidly developing field.

Expected Competencies:

By the end of this course, the student will be able to:

1- Clearly describe and express the various physical principles involved in the processing, transmission, and storage of information.
2- Comprehend the overall technologies based on semiconductors, from the atomic level to the application of components.
3- Enhance their understanding of the physical properties of semiconductors, particularly the PN junction, which serves as the basic technological building block present in all modern components, whether discrete (such as diodes or bipolar transistors) or integrated (such as field-effect transistors).

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

Modeling and Analysis of Continuous Linear Systems

Introducing

Description

This course introduces the notion of state-space representation of dynamic systems. The link with other models (transfer function, differential equation) is particularly discussed, as is how to obtain a model by linearization. Several representation bases are discussed: modal forms, control companion and observation companion. We then look at how to analyze a linear time-invariant system in terms of time response and stability properties.

Objectives

This module focuses on the representation and analysis of continuous linear dynamic systems using the state-space formalism. Students will learn how to change the representation basis, analyze stability and calculate the time response of a linear time-invariant system.

Necessary prerequisites

- Course of 2nd year IMACS « Systèmes bouclés »

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

Digital filtering

Introducing

Description

Digital Filtering
1.Signal conversion and processing (Analog / Digital, Digital /
Analog, Difference equation)
2.Discrete-Time linear systems (Z-transform, transfer function, impulse response)
3.Filter structure and Design. (FIR and IIR Filters, stability, Bilinear transform)

Objectives

Understanding of discrete time signals and discrete systems,
principles of signal theory and methods of signal processing, with emphasize on spectral analysis and digital filter design

Necessary prerequisites

- Fourier transform and series
- Laplace transform and transfer functions
- Bode diagrams

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

Numerical analysis

Introducing

Description

The course covers the following topics: numerical errors, solving non-linear equations, numerical integration, direct solutions of linear systems, matrix norms and conditioning, iterative methods for solving linear systems, least squares methods, and ordinary differential equations.

Objectives

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

Some notions of numerical analysis and scientific computing.
The student should be able to:

Choose an appropriate method for solving a mathematical problem.
Use the Python language to implement numerical analysis methods.

Necessary prerequisites

Mathematical concepts are based on undergraduate linear algebra and analysis. Practical work is based on relatively simple programming.

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

Programming in C

Introducing

Description

The student will be able to elaborate simple program illustrating algorithmic problems, but also more complex programs requiring a good knowledge of specific notions (pointer, etc.). Usual notions of programming languages (such as variables, types, control flow instructions) are presented as well as notions more specifically associated with the C language (generalized use of pointers, function parameters, input/outputs functions, etc.).

Objectives

This course aims at presenting to students the fundamental notions of the C programming language so that they can be autonomous with this language.

Necessary prerequisites

bases on Unix and computer organisation are necessary.

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

Experimental physics and stochastic modelling

Introducing

Description

Programme (detailed contents):
Experimental section :
- 5 lab sessions (7h30) chosen from the following: Temperature sensors, Vacuum technologies, Lasers, Extensometers, Thin films, Optical Measurement.
- Each practical deals with different sensors, how do they work, how to use them, how to analyse the results ?
- Statistics section:
Random modeling of measurements: systematic error, random error, confidence intervals.
Linear model: least squares adjustment, prediction intervals, model validation, model choice.
Introduction to experimental planning: optimality criteria, estimation of main effects and interaction effects of different factors.
Organization (progress):
The documents (course handout, tutorial statements, exam subjects) are available on Moodle and distributed to students.
The practical work will be carried out using a data processing tool (Excel, Python, etc.)

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Operation of the different sensors used during the lab sessions. They will know how to use them in order to solve a problem and view the results critically.
- Stochastic modelling of measurements, confidence intervals, statistical hypothesis tests, linear models.

The student will be able to build a data acquisition system starting from different sensors, to analyse the result and quantify the various components in measurement errors, to build a statistical model from observations.

Necessary prerequisites

Probabilities ans Statistics (Second year - IMACS - I2MADOPOMS20)

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

Ecological Transition, GHG Reduction, Responsibility and Environment (EARTH)

Introducing

Description

The teaching includes a "2 tonnes" workshop, which provides a fun way of understanding the orders of magnitude linked to the objectives of carbon neutrality in 2050. It also includes assignments on the following topics: housing; electricity production; inequalities and responsibilities; mobility; the climate inaction debate; agriculture and food; and aeronautics. Students also work on a complex problem linked to ecological issues, starting their reflections from an everyday object or service.

Objectives

At the end of this module, the student will be able to:

- Be comfortable with the fundamental concepts related to greenhouse gas emissions, and be able to make simple calculations on this subject.
- Know the order of magnitude of important quantities.
- Be able to fetch emission values from the ADEME database and use them appropriately.
- Think about ecological issues in all their complexity and study a specific problem
- Have an understanding of life cycle analysis and how to apply it
- Be able to research scientific literature
- Be able to understand and analyse figures/data
- Draw political conclusions from scientific facts and one's own values
- Debate, discuss and confront points of view.

Necessary prerequisites

Basic knowledge on energy.

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

Job Hunting Techniques

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

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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Humanities elective course

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 Education

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

In-depth study of electronic circuits

Introducing

Description

Electrical characteristics of diodes and transistors (MOSFETs, JFETs and bipolar transistors). Biasing circuits and corresponding amplifying classes. Models of active components and equivalent small-signal electrical schemes for LF and/or HF signal analysis. Main functions and associated circuitry (current generation, current mirrors, differential amplifiers, etc. ...). Amplifying, filtering and impedance adaptation. Implementation of models in an electrical circuit simulator.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts) :
- The electrical characteristics of diodes and transistors.
- The concept of static biasing and the principle of small signal behaviour around the bias point.
- The different amplification classes for transistors based circuits.
- The concepts of low and high frequency modelling in order to design advanced functional circuits.

The student will be able to:
- Design and realise a bias circuit which is well adapted to a given function.
- Extract the equivalent small signal scheme suited for low or high frequency signal analysis.
- Recognize and implement the basic circuitry such as differential amplification, current generators and mirrors.
- Know how to use an electrical circuit simulator and the suited models of active components as well as their limitations.
- Know how to build an amplifying and filtering chain with a view to integration.
- Conceive circuits especially adapted to sensors.
- Conceive a power amplifying stage taking into account the power dissipation.

Necessary prerequisites

Fundamentals of electricity, Kirchhoff's laws, Thévenin and Norton's and superposition theorems, voltage and current sources. Fourier's and Laplace's transforms.

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)

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse

Semiconductors

Introducing

Description

Part 1: Fundamentals of Materials Physics

Presentation of quantum mechanics concepts underlying the electronic structures of the atom.
Introduction to chemical bonding and the organization of matter.
Study of crystalline structures.
Understanding band diagrams to distinguish insulators, semiconductors, and metals, as well as the concept of density of states within a material.
Review of elementary statistical physics to explain how to modify charge densities in a semiconductor material through doping.

Part 2: Doping and PN Junction

Understanding different types of semiconductor doping.
Construction of a simple component like the PN junction, introducing band diagrams of these structures at thermodynamic equilibrium and non-equilibrium (under bias or illumination).
Study of charge carrier diffusion laws to establish the laws governing current levels observed in PN junctions under bias.

Part 3: Bipolar Transistors

Understanding the operation of the PN junction and its integration within a bipolar transistor.
Explanation of various physical properties of bipolar transistors, particularly their role as amplifiers.
Highlighting the links between the electronic properties of components and physical phenomena, such as the current gain parameters Alpha and Beta of bipolar transistors.

Part 4: CMOS Technologies

Emphasizing the physical links between materials and the electronic operation of MOS capacitors, MOS transistors, and their integration through CMOS technologies.
This course aims to provide students with the fundamental knowledge and practical skills necessary to understand and apply the principles of materials physics and components in information technologies.

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These practical sessions are an excellent opportunity to enhance your technical skills and understand the practical applications of the theoretical concepts covered in the course.

Objectives

This course introduces the physics of materials and components involved in technologies associated with the transmission, processing, and storage of information. It focuses on timeless fundamental principles in a rapidly developing field.

Expected Competencies:

By the end of this course, the student will be able to:

1- Clearly describe and express the various physical principles involved in the processing, transmission, and storage of information.
2- Comprehend the overall technologies based on semiconductors, from the atomic level to the application of components.
3- Enhance their understanding of the physical properties of semiconductors, particularly the PN junction, which serves as the basic technological building block present in all modern components, whether discrete (such as diodes or bipolar transistors) or integrated (such as field-effect transistors).

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

Waves and propagation

Introducing

Description

Program (detailed content):
Electromagnetism in dielectric, conductive, and magnetic media. Propagation of electromagnetic waves in linear, homogeneous, and isotropic media. Continuity relations. Application to reflection and refraction. Propagation in rectangular metallic waveguides and optical fibers.

Objectives

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

The fundamental concepts related to the propagation of electromagnetic waves in simple media (linear, homogeneous, isotropic, as well as dielectric, magnetic, or conductive). Reflection and refraction at the interface between two media, the functioning of metallic and dielectric waveguides (optical fibers), and the associated energy transfer.

The student should be able to:

Waves and Propagation: Use Maxwell's equations generalized for different media to determine the nature of the electromagnetic waves present in a simple system (L.H.I. medium, interface between two media, confined space between two plates of a good conductor). The student should be able to determine the conditions and characteristics of the modes that lead to the propagation of electromagnetic waves in various waveguides.

Necessary prerequisites

Electromagnetism in a vacuum

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

Hamiltonian mechanics

Introducing

Description

Newtonian mechanics, D'Alembert's principle and virtual work, Lagrangian formulation and Hamilton's principle of least action, Hamiltonian formulation, Canonical transformations and Poisson's bracket

Objectives

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

D'Alembert's principle, principle of least action, Lagrangian and Hamiltonian formulation of mechanics, notion of generalized coordinates and generalized forces, canonical transformations, Poisson representation of Hamiltonian mechanics, notion of phase space.

Students should be able to use the Euler-Lagrange and Hamiltonian equations to study the motion of an object.

Necessary prerequisites

Newtonian mechanics

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

Numerical analysis

Introducing

Description

The course covers the following topics: numerical errors, solving non-linear equations, numerical integration, direct solutions of linear systems, matrix norms and conditioning, iterative methods for solving linear systems, least squares methods, and ordinary differential equations.

Objectives

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

Some notions of numerical analysis and scientific computing.
The student should be able to:

Choose an appropriate method for solving a mathematical problem.
Use the Python language to implement numerical analysis methods.

Necessary prerequisites

Mathematical concepts are based on undergraduate linear algebra and analysis. Practical work is based on relatively simple programming.

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

Programming in C

Introducing

Description

The student will be able to elaborate simple program illustrating algorithmic problems, but also more complex programs requiring a good knowledge of specific notions (pointer, etc.). Usual notions of programming languages (such as variables, types, control flow instructions) are presented as well as notions more specifically associated with the C language (generalized use of pointers, function parameters, input/outputs functions, etc.).

Objectives

This course aims at presenting to students the fundamental notions of the C programming language so that they can be autonomous with this language.

Necessary prerequisites

bases on Unix and computer organisation are necessary.

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

Experimental physics and stochastic modelling

Introducing

Description

Programme (detailed contents):
Experimental section :
- 5 lab sessions (7h30) chosen from the following: Temperature sensors, Vacuum technologies, Lasers, Extensometers, Thin films, Optical Measurement.
- Each practical deals with different sensors, how do they work, how to use them, how to analyse the results ?
- Statistics section:
Random modeling of measurements: systematic error, random error, confidence intervals.
Linear model: least squares adjustment, prediction intervals, model validation, model choice.
Introduction to experimental planning: optimality criteria, estimation of main effects and interaction effects of different factors.
Organization (progress):
The documents (course handout, tutorial statements, exam subjects) are available on Moodle and distributed to students.
The practical work will be carried out using a data processing tool (Excel, Python, etc.)

Objectives

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

- Operation of the different sensors used during the lab sessions. They will know how to use them in order to solve a problem and view the results critically.
- Stochastic modelling of measurements, confidence intervals, statistical hypothesis tests, linear models.

The student will be able to build a data acquisition system starting from different sensors, to analyse the result and quantify the various components in measurement errors, to build a statistical model from observations.

Necessary prerequisites

Probabilities ans Statistics (Second year - IMACS - I2MADOPOMS20)

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

Ecological Transition, GHG Reduction, Responsibility and Environment (EARTH)

Introducing

Description

The teaching includes a "2 tonnes" workshop, which provides a fun way of understanding the orders of magnitude linked to the objectives of carbon neutrality in 2050. It also includes assignments on the following topics: housing; electricity production; inequalities and responsibilities; mobility; the climate inaction debate; agriculture and food; and aeronautics. Students also work on a complex problem linked to ecological issues, starting their reflections from an everyday object or service.

Objectives

At the end of this module, the student will be able to:

- Be comfortable with the fundamental concepts related to greenhouse gas emissions, and be able to make simple calculations on this subject.
- Know the order of magnitude of important quantities.
- Be able to fetch emission values from the ADEME database and use them appropriately.
- Think about ecological issues in all their complexity and study a specific problem
- Have an understanding of life cycle analysis and how to apply it
- Be able to research scientific literature
- Be able to understand and analyse figures/data
- Draw political conclusions from scientific facts and one's own values
- Debate, discuss and confront points of view.

Necessary prerequisites

Basic knowledge on energy.

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

Job Hunting Techniques

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

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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Humanities elective course

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 Education

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

Introduction to networks

Introducing

Description

The course introduction provides a general overview of network applications and their communication needs, followed by an overview of networks and their interconnection within the Internet. The central part of the course presents and illustrates the fundamental concepts associated with network design: connectivity, resource sharing, switching, quality of service and architecture (including the concepts of service and protocol). These concepts are illustrated and explored in depth within the framework of standardized local area networks and their connection to the TCP/IP Internet. A case study on Ethernet local area networks connected to the Internet (networks used in the practical work rooms) punctuates the course. The concepts are illustrated in tutorials and practical work.

Objectives

This course focuses on computer networks (local area networks, wide area networks and the Internet) from the perspective of their main concepts: connectivity, addressing, resource sharing + loss models, switching / routing + desequencing models, quality of service, architecture / service / protocol, basic protocol mechanisms.

Necessary prerequisites

C Language, Operating System, Algorithms and Programming Courses

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

C language and networks

Introducing

Description

The course is structured in two parts :
The first part presents the Socket Programming Interface (Socket API), the basic technology for coding a distributed application (particularly on) the Internet.
The second part consists of a programming project for a distributed client/server application on the Internet.

The objectives are assessed based on a project report and an assessment of student engagement during the practical sessions. An individual written exam may complete the validation of theoretical skills.

Objectives

At the end of this module:
- The student should have understood and be able to explain the fundamental concepts associated with programming distributed applications on the Internet via the Socket API
- The student should be able to use the Socket API to develop (in C language) a distributed client/server application on the Internet

Necessary prerequisites

Introduction to Operating Systems
Introduction to Computer Networks (3rd year IMACS)
C Language (3rd year IMACS)

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

Databases

Introducing

Description

The aim of this course is to study relational databases. The fundamental concepts of the relational model are studied. The emphasis is then placed on relational algebra and the SQL language for manipulating and querying databases.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- The different data models, their advantages and limits
- What is DBMS (Database management system)
- The different concepts of the relational model
- Data integrity constraints
- Relational algebra and SQL languages

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

Assembly language

Introducing

Description

Definition and role of assembly language among programming tools.
Generic assembly language notions: data operations (arithmetic, logic), memory access (addressing modes), execution control (conditional processing).
Application to ARM architecture.
Subroutine calls and returns, role of the stack, interrupts, special case of ARM architecture.
Conventions for calling functions, passing arguments, return values, context preservation.
Development of mixed C-language and ARM-language applications

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
o Von Neuman model
o Computation, storage, input-output circuits, control unit, interrupt mechanism, instruction-level pipeline execution
o Instruction set and assembly language programming
o Elements of a development chain : compiler, assembler, linker, loader, debugger
The student should be able to:
o Understand the principles of instruction set creation
o Develop an assembly language program on a microcontroller
o Use cross-development tools

Necessary prerequisites

1st year Algorithms and Programming.

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

ECTS

Hourly volume
55h

Introducing

Description

- Description and programming in Arm and x86 assembly languages.
- Description and use of a standardized C compilation chain via scripts, as well as the use of associated debugging tools.
- Description and analysis of the main aspects of the software's lower layers (function calls, data storage, associated security aspects) at C and assembly language level.
- Description and optimization of the use of hardware resources, particularly memory.
- Description and analysis of hardware vulnerabilities.

Objectives

At the end of this module, students will be able to program in assembly language, identify and correct software problems (resource under-utilization, bugs) in C and assembly language, and identify potential hardware vulnerabilities.

Necessary prerequisites

- Knowledge of computer architecture and internal functional description (processor, memory, caches).
- C language.

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

Numerical culture and skills 2

Introducing

Description

The flow of Machine Learning
Data preparation
Machine Learning Terminology
Data types
Data visualization, quality and size
Reliability
Some activation functions
Model performance
Environmental impact

Objectives

At the end of this module, which follows the 2A module, the student will have consolidated his knowledge of the field of AI: accuracy, loss function, overfitting, batch size, visualization techniques... He will also have prepared and passed a PIX certification.

Necessary prerequisites

Basics of Python programming

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

Electronics project

Introducing

Description

* LTspice training (OP, AC, DC, Step, Sweep)
* study of differential stage
* common emitter stage study, active load, current sources
* output stage design
* transistor heating, heat sink sizing
* optional routing, PCB construction of the Hifi amplifier studied and designed.

Objectives

The aim of this project is to design and build an audio amplifier using discrete transistors, with a power of around 20W, on a test plate. The power stages are studied (push-pull Darlington,etc...) as well as all the classic architecture of an operational amplifier (differential, active load...). The problem of output dynamics is clearly defined (blocking/saturation limit). The technology used is the bipolar transistor.

Necessary prerequisites

* essential: good understanding of basic electical laws
* strongly recommended prerequisites: bipolar transistor, polarization, dynamic small signal circuits

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

Telecommunication systems

Introducing

Description

Telecommunications systems: data rates, eye diagrams, transmission lines, baseband coding, analog and digital modulation, constellation diagrams, frames, multiplexing, channel access (FDMA, TDMA, CDMA), spread spectrum. The tutorials will go into greater depth on the concepts seen in class, and will focus on well-known applications of telecommunications systems (e.g. USB, Bluetooth, FM radio, etc.). Lab classes will address the design of analog and digital modulations

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts) the operating principles of telecommunication systems The student will be able to design the architecture of a telecommunication system: choice of the modulation, choice of the media accès type, etc.

Necessary prerequisites

Signal Processing courses
Analog and digital electronics courses

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

Random signals

Introducing

Description

- Introduction : deterministic signals and spectral chraracterization
- Probability theory and random signal
- Stochastic processes and random signals : first and second order characteristics, stationarity, ergodicity, discrete-time random signals
- Spectral analysis: Wiener-Kintchine Theorem
- Linear filtering

Objectives

Introduce the main concepts allowing a characterization of random signals. In particular, the main properties : stationarity, ergodicity, needed for a spectral characterization useful in electronics and automatic control, are specifically developed. The linear filtering of random signals concludes the course

Necessary prerequisites

Probability theory, random variable, Fourier Series, Fourier Transform, Linear invariant systems (Transfer function)

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

Control of continuous linear systems

Introducing

Description

State-space control: specifications, observability-commandability, state feedback (pole placement), observers, algebraic methods (1- and 2-degree-of-freedom correctors).

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts): the main methods for synthesizing state-space control laws for linear time-invariant systems
The basic principles of observer synthesis for linear time-invariant systems.
The student should be able to :
Define the major characteristics of the control law from the specifications
Design the control law in state space (pole placement)

Necessary prerequisites

Linear algebra

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

Modeling and control of discrete-event systems

Introducing

Description

Modeling and Control of Discrete Event Systems: modeling tools (finite state machines, Petri nets, Statecharts) and associated implementation techniques (PLC, FPGA, real-time target)

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
Basic principles of discrete-event system modeling tools (Finite State Machines, Statecharts, Petri nets),
Different techniques for controlling a discrete-event system (FPGA, PLC, real-time target).
The student should be able to:
model and implement the control of a discrete-event system

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

Business Game

Introducing

Description

Simulation of 5 years of company life (decision making in production, finance, marketing) using the SIMGEST business game.

Objectives

The student must have understood and be able to explain the interdependence of the company's functions (production, commercial, financial, human resources) through decision-making and analysis of the company's economic and financial results. He will have to understand how a company operates, construct financial statements, calculate costs, create simple management tools, optimize resources to make the company profitable, present an oral report of activities (in English)

Necessary prerequisites

financial management cours in 3A

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

Company Finance

Introducing

Description

Income statement, Cash flow, Balance sheet. Elements on costs. The break-even point. Taking inventory into account in financial statements. Debt financing. Company profitability.

Objectives

The student must have understood and be able to explain the company's financial summary documents as well as the basics of cost calculation in the industrial company.

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

Business Communication

Introducing

Description

Students will create a fictitious start-up in a market of their choice, conducting market analysis and identifying competitors. They will produce a GoFUND Me video and practice holding meetings and solving business challenges in English. The final presentation will be a "Shark Tank"-style competition, where students pitch their business idea to a panel of investors.

Objectives

This course aims to equip students with essential business communication skills. Students will learn to understand a simple business plan and market research, conduct meetings, and use key business vocabulary. They will develop skills to describe graphs and create high-impact presentations. Students will also practice pitching to investors, introducing a company, and discussing social and environmental responsibility in the workplace.

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

Physical Education

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 3rd 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

Societal Openness Modules

Introducing

Description

- Openness to societal issues (Energy transition, Ecological transition, Digital society, Health global, Mobility and infrastructure)

- Themes with interdisciplinary approaches, mixing Sciences & Techniques and Human Sciences and Social or Thematic in SHS complementary to the base proposed by INSA Toulouse.

Each year, the Opening Modules Commission draws up the list of MOs which will be offered in the 2nd semester. Students then choose the MO they wish to experience via a wish phase on a dedicated application. Students are informed of the MO they will follow during the month of January.

- Offered in the 2nd semester of 3A, Monday afternoon from 2 p.m. to 4:45 p.m.
- Open to all specialty pre-orientations (PO)
- Duration: 30 hours student (NB: additional personal work of around 30 hours is expected)

Educational format:
- Active pedagogies
- Face-to-face, hybrid or fully remote
- ECIU+ Challenge Based Learning possibility

Objectives

The Societal Openness Modules are courses open to the 5 societal issues addressed by INSA Toulouse, allowing complex situations to be understood and covering themes not covered in INSA courses.

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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Thermodynamics

Introducing

Description

Programme (detailed content) :
Introduction: The fundamental mathematical tools of thermodynamics: partial derivatives, Jacobian, exact and inexact total differential, Legendre transformation, notion of extensive and intensive quantities, integrating factor.

I - Part: The formalism of thermodynamics:
- Postulates for simple systems,
- Variables of state, equation of state of simple systems,
- Calorimetric coefficients of simple systems,
- Legendre transforms,
- Thermodynamic potentials, free energies of transformation, and their applications
- Stability conditions of simple systems,
- Order parameter, 1st and 2nd order phase transition.

II - Part: Applications
- thermal machines - balance and efficiency
- Perfect gases, Mixtures of perfect gases,
- Real gases, Van der Waals model
- Solid-liquid-vapour transformation of a simple system
- Changes of state,
- Phase diagram,

III - Part: Heat and matter transport phenomena
- Diffusion phenomena.
- applications: thermoelectric effects (Peltier, Seebeck, ...)

IV - Part : Thermodynamic model of the greenhouse effect.
- Modelling and influence of the atmosphere compositio

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
- The laws of thermodynamics, the notions of work, heat, energy associated with a transformation,
- The application to thermal machines, thermodynamic cycles, and the calculation of efficiency.
- This course is intended to provide students with an understanding of the laws of thermodynamics and the concepts of work, heat and energy associated with a transformation,
- simple phase diagrams and binary materials.
- This course is intended to provide students with the opportunity to learn more about the following topics: - The concepts of diffusion and heat/matter transport.

The student will have to integrate notions, contextualise them and then be able to decontextualise them to be able to project them into an adidactic situation.

Necessary prerequisites

Basics of mathematical analysis: functions of several variables, derivatives, integrations, differential equations.
General notions of thermodynamics of physical-chemical systems

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

Point defects and diffusion

Introducing

Description

Program (detailed contents):
Introduction: The role of diffusion mechanisms and defects in materials.
I- Nature of defects: volumetric, surface, linear, point defects, in crystalline materials, ionic crystals, amorphous solids.
II - Thermodynamic aspects of point defects: enthalpy of formation, enthalpy of migration, defect concentration at thermodynamic equilibrium.
III - Basics of diffusion: flow equation, Fick's laws, macroscopic aspects, microscopic aspects, calculating the diffusion coefficient, influence of temperature.
IV - Defect generation and annihilation: generation of defects by radiation exposure and diffusion (lacunae, amorphization, doping), annihilation of defects by heat treatment.
V - Electronic and optical properties: colored centers in ionic crystals, the effect of doping in semiconductor materials.
VI - Techniques for measuring defect concentration: electrical, geometric and specific heat measurements.
VII - Applications.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
- The laws of matter diffusion in solid materials.
- The nomenclature of defects present in solid materials, the mechanisms by which defects are created and annihilated, the electronic and optical properties induced, and their applications.

Students will need to integrate notions, contextualize them and then be able to decontextualize them to project them into an adidactic situation.

Necessary prerequisites

Basic mathematical analysis: functions of several variables, derivatives, integrations, differential equations.
General concepts of the thermodynamics of physical-chemical systems.

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

Quantum physics

Introducing

Description

Program (detailed content) :

Brief review of the wave function and introduction to Dirac's formalism.
Fundamental measurement postulates in quantum mechanics.
Dynamics of quantum systems.
Harmonic oscillator theory.
Kinetic momentum theory.

Main difficulties usually encountered by students :
Difficulties are essentially mathematical (new formalism and notations, solving the eigenvalue equation of a matrix, etc.).

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
Fundamental postulates of measurements in quantum mechanics.
The time evolution of a quantum system.
The notion of plane wave and localized wave packet.
Harmonic oscillator theory and its applications.
Angular momentum theory and its applications.

The student should be able to :
Solve Schrödinger's equation (energy and eigenstates) in matrix formalism.
Apply the fundamental postulates relating to the measurement of a physical quantity.
Calculate the time evolution of a quantum state.
Manipulate the ladder operators of the harmonic oscillator and angular momentum.

Necessary prerequisites

-Nanophysics: Optics, Photonics, Nanotechnologies
-Electrostatics
-Classical mechanics

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

Statistical physics

Introducing

Description

Fundamental assumptions of statistical physics. Macroscopic states, microscopic states and density of states.
Closed systems in equilibrium, microcanonical distribution. Temperature and Boltzmann distribution. Z, U and S functions. Thermodynamic link.
Closed systems in contact with a thermostat, canonical distribution.
Systems in contact with a particle reservoir, grand canonical distribution. Chemical potential.
Fermions and Bosons. Fermi Dirac and Bose Einstein distributions. Application examples.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
Basic principles of statistical physics (origin of entropy).
Microcanonical distribution, temperature, partition function and U, S functions.
Canonical and grand canonical distributions
Fermi-Dirac and Bose Einstein distributions.

The student should be able to:
Calculate the equilibrium properties of a simple closed and open system.
use the Fermi Dirac or Bose Einstein distributions in solid-state physics.

Necessary prerequisites

- Classical mecanic
- Hamiltonian Mecanic
- Thermodynamique
- Electrostatic
- Electromagnetism

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

Cohesion

Introducing

Description

Cohesion of Solids :

- Models of cohesive energy of the solid state - Lennard-Jones potential - Condon-Morse potential

- Properties and physical quantities related to cohesion: compressibility, thermal expansion, melting temperature, allotropic transformations

- Applications to ionic crystals and crystals based on van der Waals interaction

Objectives

By the end of this teaching unit, students should have understood and be able to explain (main concepts) the physical models of cohesion of solid materials on the atomic and molecular scales, as well as the links between these models and macroscopic physical quantities.

Necessary prerequisites

L2 degree in physics or materials science

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

Dislocations and deformations

Introducing

Description

Plastic deformation and fracture of crystalline materials :
- Brittleness, ductility, plasticity of crystalline materials
- Dislocations : definition, theory of dislocations, interaction, mobility and plasticity.
- Brittle fracture, cleavage.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts) the relations between defects and dislocations in the atomic structure and some macroscopic mechanical properties of crystals.

The student will be able to describe from a geometric and energetic point of view the dislocations and their interactions, and put them in relations with mechanical properties of the crystalline material : fragility and ductility

Necessary prerequisites

Know how to use tensor notation (seen during anisotropy lectures)

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

Anisotropy

Introducing

Description

Chapter 1: tensors
- Definition of tensor (use, order, transformation rules)
- Writing tensor relations: classical mathematical notation, Einstein convention, matrix notation.
- Tensors and symmetries (symmetric tensors, invariances and symmetries of the system)

Chapter 2: tensors and mechanical properties
- Definition of stress, strain, elasticity and rigidity tensors.
- The different types of stress/deformation (traction, shear).
- Voigt/engineer notation (6-component notation).
- Isotropic elasticity tensor
- Physical constants of isotropic elasticity (Young, Poisson, Coulomb moduli and Lamé coefficients).

Chapter 3: static couplings
- Direct and inverse piezoelectricity
- The piezoelectric tensor.
- The acousto-optic effect
- Couplings between static properties: general concepts and definition of effects (pyroelectricity, thermal expansion, etc.).
- Statistical theory of couplings and matrix representation (Voigt notation).
- Primary and secondary effects (e.g. primary and secondary pyroelectricity)

Chapter 4: anisotropic optics
- The representation of a tensor of order 2: the ellipsoid of indices and its geometric interpretation.
- Permittivity tensors and optical indices.
- Optical propagation along one of the main axes of an anisotropic system and the retarders (quarter-wave and half-wave blades).
- Optical propagation in any direction in an anisotropic system: birefringence and beam-splitters.

Objectives

Learn the fundamental ideas behind tensor theory and operation, as well as how they can be applied to characterize the anisotropic properties of crystals. A number of applications will be discussed in relation to anisotropic optics (wave plates, birefringence, etc.) and couplings (piezoelectricity, acousto-optic effect, etc.).

Necessary prerequisites

Linear algebra, mathematical analysis of functions with several variables, solid mechanics, wave optics.

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

Structure of solids

Introducing

Description

Crystal structure
Part 1. Geometric crystallography
Part 2. Symmetries in crystals
Part 3. X-ray crystallography

Part 1. Description of crystalline solids:
- The perfect crystal: definition and description of typical ionic and covalent structures.
- Point lattice : unit cell, Miller indices, lattice planes, interplannar spacing ;
- Crystallographic asymmetric unit;
- Reciprocal lattice: definition and properties

Part 2. Crystal symmetry
- Definitions of symmetry elements, notions of group theory, crystal systems;
- Stereographic projection and point group representations;
- Description of translational symmetry elements, space groups and representations.

Part 3. X-ray crystallography
- X-ray scattering and absorption by atoms ;
- X-ray diffraction: diffraction conditions (Laue conditions, Bragg relation, Ewald sphere), calculation of diffracted intensities (structure factor);
- Main structural characterization methods for crystals, powders and thin films
- Implementation and analysis of powder diffractograms and thin film diffractograms

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
- the structure and symmetry of crystalline solids
- X-ray diffraction by crystalline solids

The student should be able to :
- characterize the structure of a crystal, classify crystalline solids by their symmetry, orient a crystal, apply basic X-ray diffraction techniques and analyze the results of a radiocrystallography experiment.

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

Applied material physics

Introducing

Description

The experiments seen in practical work are: quantitative metallography, calorimetry, tensile tests, hardness, crystalline defects, crystallization and recrystallization, and anisotropic properties.

The concepts covered are optical microscopy, phase diagrams, image processing, calorimetry, phase transitions, mechanical properties, structural hardening, defects and crystal growth, wave propagation in anisotropic medium.

Objectives

This UF constitutes an experimental approach to the physics of materials. The educational objectives are:
- acquire scientific knowledge relating to the techniques used in material science
- acquire practical skills on these techniques,
- acquire an experimental work method in physics (how to choose the experimental parameters, carry out the experiment, analyze the results)

The student should be able to:
- reproduce and apply techniques for the development and characterization of materials among the techniques mentioned in the program.

Necessary prerequisites

- Thermodynamic prerequisite : The following notions must be seen before the practicals: enthalpy, heat capacity and phase diagram.

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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Scientific project

Introducing

Description

Based on a theme defined by a tutor, generally a teacher from the Physics department, students carry out bibliographic research to develop a better knowledge of the proposed theme.
This project is carried out in support of the physics and materials courses which take place in parallel.

Objectives

The project puts students in a real situation and shows them concrete examples of the physics of materials.
It allows you to carry out scientific research using bibliographic data and to present this research during an oral presentation.

Necessary prerequisites

No specific prerequisites.
The courses taught alongside the semester are sufficient.

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

Numerical culture and skills 2

Introducing

Description

The flow of Machine Learning
Data preparation
Machine Learning Terminology
Data types
Data visualization, quality and size
Reliability
Some activation functions
Model performance
Environmental impact

Objectives

At the end of this module, which follows the 2A module, the student will have consolidated his knowledge of the field of AI: accuracy, loss function, overfitting, batch size, visualization techniques... He will also have prepared and passed a PIX certification.

Necessary prerequisites

Basics of Python programming

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

Business Game

Introducing

Description

Simulation of 5 years of company life (decision making in production, finance, marketing) using the SIMGEST business game.

Objectives

The student must have understood and be able to explain the interdependence of the company's functions (production, commercial, financial, human resources) through decision-making and analysis of the company's economic and financial results. He will have to understand how a company operates, construct financial statements, calculate costs, create simple management tools, optimize resources to make the company profitable, present an oral report of activities (in English)

Necessary prerequisites

financial management cours in 3A

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

Company Finance

Introducing

Description

Income statement, Cash flow, Balance sheet. Elements on costs. The break-even point. Taking inventory into account in financial statements. Debt financing. Company profitability.

Objectives

The student must have understood and be able to explain the company's financial summary documents as well as the basics of cost calculation in the industrial company.

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

Business Communication

Introducing

Description

Students will create a fictitious start-up in a market of their choice, conducting market analysis and identifying competitors. They will produce a GoFUND Me video and practice holding meetings and solving business challenges in English. The final presentation will be a "Shark Tank"-style competition, where students pitch their business idea to a panel of investors.

Objectives

This course aims to equip students with essential business communication skills. Students will learn to understand a simple business plan and market research, conduct meetings, and use key business vocabulary. They will develop skills to describe graphs and create high-impact presentations. Students will also practice pitching to investors, introducing a company, and discussing social and environmental responsibility in the workplace.

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

Physical Education

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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 3rd 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

Societal Openness Modules

Introducing

Description

- Openness to societal issues (Energy transition, Ecological transition, Digital society, Health global, Mobility and infrastructure)

- Themes with interdisciplinary approaches, mixing Sciences & Techniques and Human Sciences and Social or Thematic in SHS complementary to the base proposed by INSA Toulouse.

Each year, the Opening Modules Commission draws up the list of MOs which will be offered in the 2nd semester. Students then choose the MO they wish to experience via a wish phase on a dedicated application. Students are informed of the MO they will follow during the month of January.

- Offered in the 2nd semester of 3A, Monday afternoon from 2 p.m. to 4:45 p.m.
- Open to all specialty pre-orientations (PO)
- Duration: 30 hours student (NB: additional personal work of around 30 hours is expected)

Educational format:
- Active pedagogies
- Face-to-face, hybrid or fully remote
- ECIU+ Challenge Based Learning possibility

Objectives

The Societal Openness Modules are courses open to the 5 societal issues addressed by INSA Toulouse, allowing complex situations to be understood and covering themes not covered in INSA courses.

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