INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

# SEMESTER_ T1 GP

# 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

# 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

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# Practical info

## Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES 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

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# Practical info

## Location(s)

Toulouse

# Electronic and signal processing

ECTS
5 crédits

Hourly volume
57h

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

# Introducing

## Description

## Objectives

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

-How to answer the demand of the civil society for technical and scientific information
-How to carry out critical analysis in order to give appropriate answers when questioned about such issues
-How to consider the circulation and content of information within the organizations in which they will be hired

The classes given in English will focus on the specific linguistic characteristics of the English used in scientific contexts in order for the students to understand and master them.
The students will also be made aware of the specificities of scientific English as relates to publications in his specific field of research.

Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied ¿ Chinese, German, Spanish ¿ and the level of the student.
They can be consulted on :
https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

## Necessary prerequisites

Necessary knowledge:
For classes in English : understanding of scientific English

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Physical properties of Condensed Matter 2

ECTS
4 crédits

Hourly volume
85h

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Safety, quality and applications to measurement

ECTS
4 crédits

Hourly volume
186h

# Introducing

## Description

## Objectives

This module provides a theoretical and experimental approach of the main concepts involved in the field of quality, safety, environment and measurement. The following topics are covered:
¿ design of experiments,
¿ Statistical process control.
¿ component failure
¿ Metrology and testing
¿ decision making and risk analysis

This entire course is motivating for the student by putting it in concrete situation with report to the problems they might encounter in his life as a future engineer.
In this framework, the guiding principle of the training is to focus on the one hand on the work group around applications and unifying themes and secondly, strengthening the link between academic courses of their curriculum and the concepts they will required during practical training in laboratory and/or company.

At the end of this UF, the student will:
1 - Be able to define, build and analyze an experimental design of a complex physics problem and have a critical look on the obtained results.
2 - Master the requirements of the space industry in terms of reliability as well as its normative aspects with the consequences that this can sometimes have (limitation of performances, etc...).
3 - Be aware of safety, quality, decision, environmental risks and risk analysis

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Laboratory Works Multiphysics Measurements 1

ECTS
5 crédits

Hourly volume
163h

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Condensed Matter Physics I

ECTS
4 crédits

Hourly volume

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Material Physics

ECTS
4 crédits

Hourly volume
85h

# Introducing

## Description

## Objectives

At the end of this module the student should be able to:
- structurally characterize and orient a crystal: employ of basic X-ray and electron diffraction techniques, then analysis of the results.
- describe dislocations and their interactions from a geometric and energetic point of view, and relate them to the mechanical properties of the crystalline material: fragility and ductility
- calculate and predict electrical, thermal and mechanical effects resulting from electrical, thermal and mechanical solicitations applied to the crystal in particular directions.
- master the piezoelectric effect for applications of sensors and micro-actuators, and acousto-optical and electro-optical effects for applications of filtering, modulation or optical addressing and optoelectronic components.

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Experimental physics and stochastic modelling

ECTS
5 crédits

Hourly volume
59h

# Introducing

## Description

## 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 in order to confirm or invalidate hypotheses concerning the problem at hand, and to plan experiments in simple cases.

## Necessary prerequisites

I2AIMT21 Probability in IMACS

## Évaluation

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# Practical info

## Location(s)

Toulouse

# C language, Numerical analysis and Computer networks

ECTS
6 crédits

Hourly volume
71h

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse

# Micro-nano technologies

ECTS
3 crédits

Hourly volume
23h

# Introducing

## Description

## Objectives

The goal of the course is to introduce the techniques used in the micro-electronics industry for the fabrication of integrated circuits (photolithography, growth and deposition of thin films, doping, etching techniques), as well as various optical and electrical characterization techniques.
The physical and the chemical processes involved in these techniques are studied.

The complete fabrication process of NMOS and CMOS circuits is presented.

The students are also initiated to the design and the simulation of integrated circuits.

## Necessary prerequisites

Semiconductor physics (electrons, holes, doping, band structure).
Design and working principle of basics electronics components (PN junction, MOS transistor).

## Évaluation

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# Practical info

## Location(s)

Toulouse

# From the sensor to the test bench in open source hardware

ECTS
3 crédits

Hourly volume
92h

# Introducing

## Description

## Objectives

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

THE MANUFACTURING OF ¿low tech¿ SENSORS based on graphite: with elements of physics (electronic transport) allowing the understanding of the electrical characteristics of a sensor based on a granular system (graphite nanoparticles).

SENSORS AND ACQUISITION CHAIN:
- The criteria for the design and use of this sensor and an adapted acquisition chain
It will be capable of handling:
- The physical principles of sensors operation
- The concepts used in metrology
- Procedures implemented,
- electrical "conditioners"
- The design of an acquisition chain.

DESIGN OF A CIRCUIT IN ANALOG ELECTRONICS:
It will be able to design and simulate an amplification stage dedicated to the measurement of the sensor realized

MICROCONTROLERS AND OPEN SOURCE HARDWARE:
Elements to master the microcontrollers allowing the design and implementation of concrete applications in Open Source Hardware,
- The architecture and operation of ATMEL AVR microcontrollers,
- Programming in the C and C++ language of the Arduino and IDE development environment,
- Creating his own libraries and programs,
- Creating its own human/machine interfaces: in Arduino / Processing, Android and python,
- The achievement of its own circuit boards (PCB + Eagle...)
- Board interfacing with various devices (displays, motors, sensors, Nunchuk, touch screens, I2C bus, wifi, Bluetooth LE ...)
- Intellectual property in open source hardware

REALIZATION OF AN ANDROID APPLICATION:
He will be able to create an ANDROID application to retrieve data from the graphite sensor.

REALIZATION OF A TEST BENCH ADAPTED TO THE SENSOR
He will be able to build a bench allowing characterizing in a optimal and reproducible way the electrical characteristics of the sensor.

REALIZATION OF THE SENSOR DATASHEET
Finally, he will realize the data sheet of the sensor realized.

## Necessary prerequisites


Non-contractual information

Knowledge of Fortran, C and even C++
Knowledge of algorithmic

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# Practical info

## Location(s)

Toulouse

# Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

# Introducing

## Description

## Objectives

At the end of this module, the student will

¿ Know the legal environment and responsibilities of a business
activity
¿ Be able to objectively assess the financial health of a company and evaluate the rentability of an investment
¿ Realize a market diagnosis (benchmarking) and a business diagnosis in order to make decisions and set goals and strategies
¿ Collect the market data and put in action a business plan adapted to the means and goals of the company
Module L 2
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## Necessary prerequisites

Management I3CCGE51

## Évaluation

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# Practical info

## Location(s)

Toulouse

# [FRANCAIS] scénarios énergétiques

ECTS
3 crédits

Hourly volume

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse

# [FRANCAIS] APS pour formation continue

ECTS
4 crédits

Hourly volume

# Introducing

## Description

## Évaluation

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# Practical info

## Location(s)

Toulouse



Non-contractual information