INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

5th YEAR GP_PHYSICAL INSTRUMENTATION COURSES

Practical info

Location(s)

Toulouse

Instrumentation Lab

ECTS
5 crédits

Hourly volume
35h

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Nanobioengineering

ECTS
5 crédits

Hourly volume
27h

Introducing

Objectives

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

- Nanotechnological processes for the investigation, the sensing and the quantification of biomolecular specific interactions, basis of all biosensing technologies.

- The principle of some of these technologies: Fluorescence, soft lithography, surface biofunctionalization, single molecule assays, biochips, 3D lithography, microfluidic.

The student will be able to:
- Formulate nanoscale mechanisms and give precise examples of biomolecular specific interactions
- Master nanoscale technics for transducing a molecular event into a measurable signal
- Analyze any kind of biosensor
- Implement a scientific experimental investigation
-Implement these nanotechnological and fluidic processes
- Discuss results, give interpretations and set the l advantages as well as limitations,
- Gather different concepts; assimilate them for being able to extract them from their context in order to face adidactical situations.

Necessary prerequisites

- Initiation to micro/nano-biotechnologies
- Scientific M1 in Chemistry, Biology or Physics

Practical info

Location(s)

Toulouse

Gas Sensor

ECTS
5 crédits

Hourly volume
34h

Introducing

Objectives

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

- the approach and the different steps for the conception and realization of a micro- and nano-electronic by integration of nano-objects synthesized as a colloidal solution;
- the operating model of a nano-sensor

the student will have understood and be able to explain:
- the main concepts and the experimental practices about nano-object synthesis and stabilization of colloidal solutions;
- the main concepts and the experimental practices about deposition of nano-objects from a solution into 2D and 3D arrays on a surface;
- the physical principles of nanoparticles based sensors (gaz sensor, strain sensor ¿).

The student will be able to:
- produce a sensor relying on nanoparticle arrays with particles synthesized and assembled during the project;
- measure the sensor properties and describe how it works;
-discuss the results obtained and suggest improvements..

The student will be able to:
- suggest a reasonable solution for the realization of a sensor gathering the different concepts described above;
- produce an expertise on the conception and the practical realization on a novel sensor.

Necessary prerequisites

Master 1 in Physics, Applied Physics, Chemistry or Material Science or equivalent

Practical info

Location(s)

Toulouse

Micro-nano-electro-mechanical systems ¿ Nanotechnology Engineering

ECTS
5 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

New 2D matérials

ECTS
5 crédits

Hourly volume
68h

Practical info

Location(s)

Toulouse

Charged particle optics

ECTS
5 crédits

Hourly volume
30h

Introducing

Objectives

Charged particle optics (CPO) is a science that compiles under a common theoretical base all the laws governing the transport, focusing, mass/energy dispersion, etc. of charged particles that can be electrons, positrons, ions or molecules. It allows the description of the optical properties of all the usual individual optical elements (lenses, energy filter, magnetic sector, etc.) and thanks to the multiple combinations of these elements, it allows the creation of a wide range of tools for the characterisation of innovative materials. For years, applications in this field have been considerable: development of increasingly powerful electron microscopes, focused ion beams that have opened the way to nano-manufacturing, secondary ion mass spectrometers (SIMS), an essential tool for characterising dopants in semiconductors, and also large instruments such as synchrotrons and particle accelerators.For several years, the demand for engineers with solid skills in this field has been significant and has been increasing regularly.

Indeed, the companies providing state-of-the-art analysis instruments are in a permanent race to innovate, on the one hand to meet the needs of the original market of increasingly small and complex semiconductor devices, but also to meet new markets such as the characterisation of chemical materials (pharmaceutical molecules, etc.) or biological materials (viruses, etc.) and the development of medical instruments (proton therapy for example). The development in the early 2000s of spherical aberration correctors for electron microscopes, whose innovative optics are based on the symmetry properties of magnetic multipoles, is an emblematic example that has revolutionised the use of these instruments.

In order to respond to this craze and to the demand for innovation that will enable the instruments of the future to be imagined, the industrial world is looking for engineering schools that can offer a modern approach to OPC adapted to their needs.

This module will aim to develop the theoretical foundations of OPC by insisting on the practical aspects useful for the development of new innovative optical instruments. The course will insist in particular on the strength of the general formalism of the OPC which gathers under the same logic all the elements which can transport, focus or disperse charged particles. The tutorials around simulations using the SIMION software (https://simion.com/docs/simion8brochure.pdf) and practical work will allow the engineering students to put this knowledge into practice around a design project of a concrete optical system such as, for example

- the manufacture of an electrostatic electron microscope whose elements, previously dimensioned with SIMION, can be manufactured with a 3D printer.

We would like to focus this module on aspects of the OPC that are of interest to industry and we will be in contact with Orsayphysics, a French manufacturer of focused ion beams. A visit to the company may even be considered, depending on requests and availability.

Necessary prerequisites

Electromagnetism, GP 4A Advanced Geometrical Optics, Fourier optics, quantum mechanics, and an approach to point mechanics problems using Lagrange's variational principle would be a plus.

Practical info

Location(s)

Toulouse

Advenced intrumentation 1

ECTS
5 crédits

Hourly volume
62h

Practical info

Location(s)

Toulouse

Instrumentation advanced 2

ECTS
4 crédits

Hourly volume
58h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
Real Time : Real time concept, scheduling, rules to develop a real time application, determinism and jitter concepts
Can Bus : General CAN concept, from concept to protocol
Network : Interest of local network for tests and measurements applications.

The student will be able to:
Real Time : Develop a real time application running on National Instruments Compact RIO
Can Bus : Manage communication between two CAN nodes
Network : Manage network technologies to realise a simple project

Necessary prerequisites

General computing
LabVIEW programming
Labwindows/CVI programming

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Physics Engineering and Economic Development

ECTS
5 crédits

Hourly volume
75h

Introducing

Objectives

This educational unit is composed of three distinct lectures. Two of them are technological: Physics of semiconductor heterostructures and Telecommunication satellites/RF Functions, the third being centered on the impact of modern science: Nano Cultures.

Multiple objectives are targeted:

- Acquire the fundaments of the recent innovations in semi-conductor devices for microelectronic industry
- Understanding and modelling of semiconductor heterostructures
- To be able to describe the basic Telecommunication payload architecture by understanding the functional description of a bent-pipe transponder
- To acquire good understanding of each RF equipment (Requirements, RF drivers, technologies and associated tips)
- Develop a personal thinking on the impact of sciences on society fin relation with global environemental changes
- Analyse and criticize the nature of Science and technology
- Construct a research project forming sense with respect to personal values and societal challenges

Necessary prerequisites

- Course on "semiconductors" given in 3IMACS.
- Use of decibel units
- RF basics (noise, gain¿)

Practical info

Location(s)

Toulouse

Applied physics and Scientific Communication

ECTS
5 crédits

Hourly volume
28h

Practical info

Location(s)

Toulouse

Human relations

ECTS
6 crédits

Hourly volume
78h

Introducing

Location(s)

Toulouse

Objectives

L'étudiant devra être capable de :
-Analyser des situations de groupe avec des concepts issus de la psychologie sociale
-Identifier les dimensions éthiques de ces situations et prendre position
-Repérer et comprendre des informations liées aux RH
-Analyser une situation de management d¿équipe en référence à un cadre théorique
-Formuler et argumenter des solutions managériales
-Agir dans un milieu naturel : analyser, décider, agir ; mettre en œuvre la sécurité, utiliser du matériel spécifique. découvrir un site.
-Respecter et s'intégrer dans un environnement différent de ses habitudes
-S'engager avec cohérence dans le projet d'activités
-Prendre part activement au collectif
-Valider son projet professionnel et construire une stratégie pour trouver un emploi

Necessary prerequisites

None

Practical info