INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

FOURTH YEAR – AE

Practical info

Location(s)

Toulouse

Architectures or technological systems

ECTS
7 crédits

Hourly volume
93h

Introducing

Objectives

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

Power transmissions
-Needs for power, associated functions, power architectures in technological systems (mechanic, hydraulic, electric)
-The interest of system modeling, methods and tools,

Computer science & Electronics
- the interest to have a common modeling graphical language, the concepts relative to a object oriented approach.
- Industrial network introduction, interface eelctronics

The student will be able to:
Power transmissions
- identify and structure the power needs (supply, meter, distribute, transform, condition, manage, etc)
- analyse a schematic of a power system (mechanical, hydraulic, electric) at an architectural and functional level
- assess/list/compare solutions for implementing a given function of power transmission
- synthesize a power architecture (mechanical, electrical, electric) from functional needs

Computer science & Electronics
- how to choose the most appropriate diagrams depending on the approach: structure, behaviour, interaction
- Propose an object-oriented UML model of a system
- Implement a technological solution on a mechatronic system

Necessary prerequisites

Basic technological knowledge in mechanics, hydraulics, electrics

Practical info

Location(s)

Toulouse

Multiphysics modeling

ECTS
6 crédits

Hourly volume

Location(s)

Toulouse

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Lumped (0D/1D) and distributed (3D) parameters models for Multiphysic systems.
- Network approach for lumped parameters models, Acausal/causal concepts, bond graph, Finite Element Methods.

The student will be able to:
- Set up 0D/1D (electrical, mechanical, hydraulical, thermal) and 3D models (mechanical) for mechatronics systems.
- Use 0D/1D platforms such as : Dymola/Modeilca, AMESim, Simulink.
- Use 3D platforms such as : Patran/Nastran or Abaqus

Necessary prerequisites

Kirchhoff laws, electrocinetic, work/energy/power, pressure and hydrostatic, conduction/convection, heat transfer.
Strength of material for BSME.

Practical info

Modelling tools and Optimization

ECTS
5 crédits

Hourly volume

Introducing

Objectives

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

- Various approaches to analyze and evaluate the performances of discrete event system DES,
- Various types of modelling adapted to the problems considered (deterministic or stochastic models , numerical and combinatorics optimization models, models of concurrency)
- Algorithms available to solve these problems.

The student will be able to:

Model and solve operational research problems (optimisation, linear programming, graphs, stochastic process) and discrete-event systems problems.

Model stochastic systems, such as a network of queues , using Markov chains. Compute their stationary performance measures, and dimension their capacity.

Model a DES by Petri net, analyse the properties of the Petri net by various methods of analysis (exhaustive and structural)

Necessary prerequisites

Linear Algebra, Differential Calculus, Probabilities, Dynamic systems, Basic concepts in propositional logics and in Petri Nets.

Practical info

Location(s)

Toulouse

Automatic control

ECTS
4 crédits

Hourly volume

Introducing

Objectives

For GM students, this course is a practical extension of the continuous marking methods seen in the previous year.
Optional part for AE: Understand the basic principles and constraints of hardware in the loop (HIL) simulations.

All students follow the end of the UF which deals with numerical control techniques and methods.

The student will be expected to be able to:
- Model a discrete system or discretize a continuous system.
- Give the performance of a discrete system.
- Synthesize a discrete control following a specification (performance) and implement it.

Necessary prerequisites

- AE-SE :
Feedback systems (I2MAAU11)
Control and computer architecture (I3MAAU11)
Control of Linear Time Invariant Systems (I3MAAU21)

- GM-IS :
Dynamic Systems (I3ICDM11)

Practical info

Location(s)

Toulouse

Non-contractual information

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

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

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

Non-contractual information

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

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
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

Practical info

Location(s)

Toulouse

Toulouse School of Management

Practical info

Location(s)

Toulouse

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Device modeling and digital circuits architectures (reconfigurable computing)

ECTS
5 crédits

Hourly volume
55h

Introducing

Objectives

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

-the electronic device and digital electronic systems modelling
-the issue of the integration of electronic circuits
-the design and performance optimisation of digital architectures especially in frequency and power consumption. Ultra low power architectures will be studied for sustainable development.
- the technologies for green computing
- reconfigurable computing using FPGAs
-digital architectures dedicated to embedded Artificial Intelligence (AI)

The student will be able to understand the models of main electronics active devices and digital complex architectures and their optimisation for sustainable development The student will be prepared for the future technological breakout in their professional life.

Necessary prerequisites

Electrical circuits, electrostatics, analog and digital electronics, computer engineering

Practical info

Location(s)

Toulouse

Non-contractual information

Analog electronic system architecture

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Dimension and design of analog electronic functions of information processing (filtering,
amplification, automatic gain control, voltage controlled oscillators, modulators / demodulators AM and FM;
-Optimize the signal to noise ratio in each subset of an embedded system
-Modeling architectures for robust usage constraints (consumption, temperature to dissipate), the
thermal variations of the environment and dispersions characteristics of components

Practical info

Location(s)

Toulouse

[FRANCAIS] Analyse des systèmes complexes

ECTS
4 crédits

Hourly volume
50h

Introducing

Objectives

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

- Principles, difficulties and limits of the modelling of systems with multiple inputs and multiple outputs.
- Design and implementation of control of systems with multiple inputs and multiple outputs.
- Main possible and observable behaviors which can occur in the nonlinear systems (equilibrium states, limit cycles, complex behaviors) and their evolution by variation of the parameters.
- Basis of the theory of Lyapunov

The student will be able to:
- To apprehend the implementation of the control of a process with multiple inputs and multiple outputs.
- To begin the analysis of a nonlinear system by various techniques (qualitative, geometrical, and simulations)
- To lean on numerical analysis (Matlab©) to establish, confirm, validate, simulate and implement the theoretical results discussed during the courses.

Necessary prerequisites

- Cours de 2e année « Systèmes bouclés » (I2MAAU11)
- Cours 3e année IMACS « Modélisation et analyse des systèmes linéaires » (I3AMAU11)
- Cours 3e année IMACS « Commande des systèmes » (I3AMAU12

Practical info

Location(s)

Toulouse

Digital signal acquisition architectures and Computed controlled systems

ECTS
4 crédits

Hourly volume
60h

Introducing

Objectives

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

The complete modelling from sensor to actuator is presented, associated with digital control technics. A specific labwork deal with the implementation of a complete chain of acquisition and digital processing in order to carry out the control of an actuator.

Practical info

Location(s)

Toulouse

[FRANCAIS] Informatique matérielle

ECTS
3 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain:
- Programming specificities of the peripheral units for microcontroller.
- The different peripherals of a microcontroller and their behaviour.
- How to take into account hardware constraints for the design of embedded system.

The student will be able to:
- To select an architecture processor adapted to the software application and to the process configuration.
- To conceive and test the techniques of the programming by hardware interruption.
- To use debug tools o and test in the context of cross-development.
- To find information into datasheet

Practical info

Location(s)

Toulouse

QSE APS 4A GEI – 1

ECTS
4 crédits

Hourly volume
67h

Practical info

Location(s)

Toulouse

Non-contractual information

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

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
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.

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

Necessary prerequisites

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Machine Learning

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
1 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
5 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

French I

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

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

Necessary prerequisites

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Practical Work in Control

ECTS
3 crédits

Hourly volume
34h

Toulouse

Introducing

Objectives

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

This teaching illustrates all the 4th year automation courses (control of nonlinear systems, optimal control, numerical control, multi-variable control, graphs).

The student should be able to:
- Model/identify a system
- Synthesize a control according to a specification (performance) and implement it
- Know how to be critical on a command
- Know how to write a report

Necessary prerequisites

Analysis of non-linear systems - Multivariable systems - Peripherals - Numerical control - Acquisition chains and numerical control - optimal control - graph

Practical info

Location(s)

Energy management for embedded systems

ECTS
3 crédits

Hourly volume

Introducing

Objectives

- At the end of this module, the student will have understood and be able to explain (main concepts):
- The characteristics of the energy sources that can be used on embedded systems,
- The characteristics of quantities in electrical distribution networks
- Power converter architectures,
- The modeling of an electric motor/generator based on its coupled electrical and mechanical values.
- The operation of a transformer and its model.
- The structures and main characteristics of single-phase and three-phase AC-DC converters.
- The main chopper structures, their properties, reversibilities and their control.
- The principle of torque and/or speed regulation of a DC machine using a chopper.

The student should be able to:
- Analyze the energy needs of an on-board system and propose and size a solution,
- Use coupled electrical and mechanical equations to model an electro-mechanical system
- Analyze a mechanical system and identify the drive requirements, the type of converter that must be associated with the machine.
- Dimension the elements of an electrical energy conversion chain which allows to drive a given actuator.

Necessary prerequisites

General knowledge of electricity, alternating current, electrical circuits, analog and digital electronics as well as
mathematical tools (Fourier and Laplace transforms) and
the basics of automatic control (transfer functions and block
diagrams)

Practical info

Location(s)

Toulouse

Discrete and Continuous Systems Optimisation

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
- different approaches to analyse, evaluate the performance of discrete event systems through different
models (deterministic or stochastic, graphs) and to optimise them (linear programming)
- the optimisation methods for continuous systems :
-static (first and second order conditions)
- dynamic (dynamic programming)
- their applications to optimal or model predictive control mainly for linear systems

The student will be able to:
- to analyse, model and solve an optimization problem of
discrete systems by a linear programming or a graph, by
applying relevant algorithms (simplex, usual graphs and
networks algorithms, combinatorial optimization)
- to model and to characterize: stationary Makovian processes with discrete state space (chains) and
continuous or discrete time, queuing systems, to analyse
their transient and stationary behaviours, to evaluate their
performances
- to model a discrete event systems by Petri nets and to analyse the properties by enumerative and structural approaches.
- to formalise and solve a quadratic criterion, nonlinear,
without or with constraints optimisation problem in the case
of systems with real variables
-to develop and design an optimal control law (LQG) for a
linear or linearized process.

Necessary prerequisites

Linear algebra ¿ Probabilities ¿ Dynamic systems (state concept) - Basic elements in logic systems and Petri nets.

Practical info

Location(s)

Toulouse

Research project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involves a team of 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its proj

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Computer science

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Object-Oriented Programming part:
. The principles of object-oriented programming: method call, classes.
.The application of those notions for programming connected objects

- Networks part:
. The basic concepts and techniques allowing interconnecting local area networks in the Internet: repeater, bridge, router
.the basic concepts and techniques allowing interconnecting LAN in the Internet : subnetting, CIDR, VLAN, VPN, applicative proxy, NAT
. the main protocols of the TCP/IP Internet architecture : UDP, TCP, IP, ARP/proxy ARP, ICMP, DHCP, RIP, OSPF, BGP

- Real-Time part:
.Designing real time applications.
. Understand and manipulate a real time kernel.

The student will be able to:
- Oject-Oriented Programming part:
. Develop java applications, using a modular object-oriented style.

- Networks part:
.Do architecture choices allowing to take into account requirements and constraints associated to a LAN interconnection.
. Do basic or complex addressing and routing schemas.
. Set up (administrate) Ethernet and IP networks in the basic and advanced interconnection contexts considered in the course.

- Real-Time part
.Set up a design methodology to respond to a specification.
. Design software architectures for real time applications.
. Ajust the tasks parameters to reach the expected performances.
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- Simulate and analyze real-time applications performance

Necessary prerequisites

Software Engineering, introduction to networking, C programming

Practical info

Location(s)

Toulouse

Improving one's autonomy and building one's own professional project level 2 S

ECTS
4 crédits

Hourly volume
40h

Practical info

Location(s)

Toulouse

Non-contractual information

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

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 :
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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

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Non-contractual information

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Systems Engineering processes

ECTS
5 crédits

Hourly volume
77h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
What are the engineering processes to develop a system, how they must be implemented and managed in companies, what are the associated standards.

The student will be able to:
- define, capture, analyze and express the stakeholders
- needs
- transform the needs into requirements
- define several logical and physical solutions from the needs, evaluate them and choose one manage development processes

Practical info

Location(s)

Toulouse

Object-Oriented and Real-Time Programming

ECTS
3 crédits

Hourly volume
50h

Introducing

Objectives

This module consists of two parts:
- The part on real time systems introduces real time systems, key concepts, applications, constraints, and teaches the programming of these systems using the services of real time operating systems.
-At the end of the object programming part, students will be able to produce C++ code from a UML class diagram with relationships, inheritance and polymorphism.

Practical info

Location(s)

Toulouse

Dynamics of structures and control

ECTS
4 crédits

Hourly volume
22h

Introducing

Objectives

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

Vibrations of mechanical systems and structures.

Controlling the articulated systems and flexible structures.

The global and local modelling of electromagnetic actuators.

Necessary prerequisites

Basis in electromagnetism, solid mechanics and control

Practical info

Location(s)

Toulouse

Mechatronic project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- power and information channels of mechatronic systems
- the place of system simulation activities in the design cycle (V design cycle) of complex systems
- the principle of data acquisition with computers

The student will be able to:
- Establish models suitable for various engineering tasks during the design of mechatronic systems.
- Implement models in a system simulation environment and perform validation and verification tasks associated to the V design cycle.
- Specify and conduct model-in-the-loop and software-inthe-loop activities for a complex system.
- Design the different elements of a simple data acquisition system
- Implement a graphical programming language dedicated to the acquisition (LabVIEW)
- Perform a security analysis
- Perform a lifecycle analysis with a dedicated software

Necessary prerequisites

Basics of mechanics, electronics, heat transfer, and automation.

Basic of algorithmic

Practical info

Location(s)

Toulouse

Research Initiating Project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involves a team of 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a projectif report and prepare a presentation in english for its project defense.

Practical info

Location(s)

Toulouse

Quality, security, environment and sports

ECTS
4 crédits

Hourly volume
61h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain the main principles and definitions of quality management, the importance of health and safety at work, how to assess and prevent risks, eco-design and life-cycle analysis.

The students will be able to develop their capabilities in eco design in a project related to mechatronics.

Sports:
The student will have to build a project with his team by:
- Taking into account everyone's skills,
- Seeking to enhance the strengths of each partner and compensate potential weaknesses.
- Analyzing the balance of power they will be confronted with.

Practical info

Location(s)

Toulouse

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

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
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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

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Non-contractual information

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
1 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Challenge – Formation ECIU

ECTS
5 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

French II

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Architectures or technological systems

ECTS
7 crédits

Hourly volume
93h

Introducing

Objectives

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

Power transmissions
-Needs for power, associated functions, power architectures in technological systems (mechanic, hydraulic, electric)
-The interest of system modeling, methods and tools,

Computer science & Electronics
- the interest to have a common modeling graphical language, the concepts relative to a object oriented approach.
- Industrial network introduction, interface eelctronics

The student will be able to:
Power transmissions
- identify and structure the power needs (supply, meter, distribute, transform, condition, manage, etc)
- analyse a schematic of a power system (mechanical, hydraulic, electric) at an architectural and functional level
- assess/list/compare solutions for implementing a given function of power transmission
- synthesize a power architecture (mechanical, electrical, electric) from functional needs

Computer science & Electronics
- how to choose the most appropriate diagrams depending on the approach: structure, behaviour, interaction
- Propose an object-oriented UML model of a system
- Implement a technological solution on a mechatronic system

Necessary prerequisites

Basic technological knowledge in mechanics, hydraulics, electrics

Practical info

Location(s)

Toulouse

Multiphysics modeling

ECTS
6 crédits

Hourly volume

Location(s)

Toulouse

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Lumped (0D/1D) and distributed (3D) parameters models for Multiphysic systems.
- Network approach for lumped parameters models, Acausal/causal concepts, bond graph, Finite Element Methods.

The student will be able to:
- Set up 0D/1D (electrical, mechanical, hydraulical, thermal) and 3D models (mechanical) for mechatronics systems.
- Use 0D/1D platforms such as : Dymola/Modeilca, AMESim, Simulink.
- Use 3D platforms such as : Patran/Nastran or Abaqus

Necessary prerequisites

Kirchhoff laws, electrocinetic, work/energy/power, pressure and hydrostatic, conduction/convection, heat transfer.
Strength of material for BSME.

Practical info

Modelling tools and Optimization

ECTS
5 crédits

Hourly volume

Introducing

Objectives

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

- Various approaches to analyze and evaluate the performances of discrete event system DES,
- Various types of modelling adapted to the problems considered (deterministic or stochastic models , numerical and combinatorics optimization models, models of concurrency)
- Algorithms available to solve these problems.

The student will be able to:

Model and solve operational research problems (optimisation, linear programming, graphs, stochastic process) and discrete-event systems problems.

Model stochastic systems, such as a network of queues , using Markov chains. Compute their stationary performance measures, and dimension their capacity.

Model a DES by Petri net, analyse the properties of the Petri net by various methods of analysis (exhaustive and structural)

Necessary prerequisites

Linear Algebra, Differential Calculus, Probabilities, Dynamic systems, Basic concepts in propositional logics and in Petri Nets.

Practical info

Location(s)

Toulouse

Automatic control

ECTS
4 crédits

Hourly volume

Introducing

Objectives

For GM students, this course is a practical extension of the continuous marking methods seen in the previous year.
Optional part for AE: Understand the basic principles and constraints of hardware in the loop (HIL) simulations.

All students follow the end of the UF which deals with numerical control techniques and methods.

The student will be expected to be able to:
- Model a discrete system or discretize a continuous system.
- Give the performance of a discrete system.
- Synthesize a discrete control following a specification (performance) and implement it.

Necessary prerequisites

- AE-SE :
Feedback systems (I2MAAU11)
Control and computer architecture (I3MAAU11)
Control of Linear Time Invariant Systems (I3MAAU21)

- GM-IS :
Dynamic Systems (I3ICDM11)

Practical info

Location(s)

Toulouse

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

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

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

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
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

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Device modeling and digital circuits architectures (reconfigurable computing)

ECTS
5 crédits

Hourly volume
55h

Introducing

Objectives

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

-the electronic device and digital electronic systems modelling
-the issue of the integration of electronic circuits
-the design and performance optimisation of digital architectures especially in frequency and power consumption. Ultra low power architectures will be studied for sustainable development.
- the technologies for green computing
- reconfigurable computing using FPGAs
-digital architectures dedicated to embedded Artificial Intelligence (AI)

The student will be able to understand the models of main electronics active devices and digital complex architectures and their optimisation for sustainable development The student will be prepared for the future technological breakout in their professional life.

Necessary prerequisites

Electrical circuits, electrostatics, analog and digital electronics, computer engineering

Practical info

Location(s)

Toulouse

Analog electronic system architecture

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Dimension and design of analog electronic functions of information processing (filtering,
amplification, automatic gain control, voltage controlled oscillators, modulators / demodulators AM and FM;
-Optimize the signal to noise ratio in each subset of an embedded system
-Modeling architectures for robust usage constraints (consumption, temperature to dissipate), the
thermal variations of the environment and dispersions characteristics of components

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Analyse des systèmes complexes

ECTS
4 crédits

Hourly volume
50h

Introducing

Objectives

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

- Principles, difficulties and limits of the modelling of systems with multiple inputs and multiple outputs.
- Design and implementation of control of systems with multiple inputs and multiple outputs.
- Main possible and observable behaviors which can occur in the nonlinear systems (equilibrium states, limit cycles, complex behaviors) and their evolution by variation of the parameters.
- Basis of the theory of Lyapunov

The student will be able to:
- To apprehend the implementation of the control of a process with multiple inputs and multiple outputs.
- To begin the analysis of a nonlinear system by various techniques (qualitative, geometrical, and simulations)
- To lean on numerical analysis (Matlab©) to establish, confirm, validate, simulate and implement the theoretical results discussed during the courses.

Necessary prerequisites

- Cours de 2e année « Systèmes bouclés » (I2MAAU11)
- Cours 3e année IMACS « Modélisation et analyse des systèmes linéaires » (I3AMAU11)
- Cours 3e année IMACS « Commande des systèmes » (I3AMAU12

Practical info

Location(s)

Toulouse

Digital signal acquisition architectures and Computed controlled systems

ECTS
4 crédits

Hourly volume
60h

Introducing

Objectives

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

The complete modelling from sensor to actuator is presented, associated with digital control technics. A specific labwork deal with the implementation of a complete chain of acquisition and digital processing in order to carry out the control of an actuator.

Practical info

Location(s)

Toulouse

[FRANCAIS] Informatique matérielle

ECTS
3 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain:
- Programming specificities of the peripheral units for microcontroller.
- The different peripherals of a microcontroller and their behaviour.
- How to take into account hardware constraints for the design of embedded system.

The student will be able to:
- To select an architecture processor adapted to the software application and to the process configuration.
- To conceive and test the techniques of the programming by hardware interruption.
- To use debug tools o and test in the context of cross-development.
- To find information into datasheet

Practical info

Location(s)

Toulouse

QSE APS 4A GEI – 1

ECTS
4 crédits

Hourly volume
67h

Practical info

Location(s)

Toulouse

Non-contractual information

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

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
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

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Machine Learning

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

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
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

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Practical Work in Control

ECTS
3 crédits

Hourly volume
34h

Toulouse

Introducing

Objectives

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

This teaching illustrates all the 4th year automation courses (control of nonlinear systems, optimal control, numerical control, multi-variable control, graphs).

The student should be able to:
- Model/identify a system
- Synthesize a control according to a specification (performance) and implement it
- Know how to be critical on a command
- Know how to write a report

Necessary prerequisites

Analysis of non-linear systems - Multivariable systems - Peripherals - Numerical control - Acquisition chains and numerical control - optimal control - graph

Practical info

Location(s)

Energy management for embedded systems

ECTS
3 crédits

Hourly volume

Introducing

Objectives

- At the end of this module, the student will have understood and be able to explain (main concepts):
- The characteristics of the energy sources that can be used on embedded systems,
- The characteristics of quantities in electrical distribution networks
- Power converter architectures,
- The modeling of an electric motor/generator based on its coupled electrical and mechanical values.
- The operation of a transformer and its model.
- The structures and main characteristics of single-phase and three-phase AC-DC converters.
- The main chopper structures, their properties, reversibilities and their control.
- The principle of torque and/or speed regulation of a DC machine using a chopper.

The student should be able to:
- Analyze the energy needs of an on-board system and propose and size a solution,
- Use coupled electrical and mechanical equations to model an electro-mechanical system
- Analyze a mechanical system and identify the drive requirements, the type of converter that must be associated with the machine.
- Dimension the elements of an electrical energy conversion chain which allows to drive a given actuator.

Necessary prerequisites

General knowledge of electricity, alternating current, electrical circuits, analog and digital electronics as well as
mathematical tools (Fourier and Laplace transforms) and
the basics of automatic control (transfer functions and block
diagrams)

Practical info

Location(s)

Toulouse

Discrete and Continuous Systems Optimisation

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
- different approaches to analyse, evaluate the performance of discrete event systems through different
models (deterministic or stochastic, graphs) and to optimise them (linear programming)
- the optimisation methods for continuous systems :
-static (first and second order conditions)
- dynamic (dynamic programming)
- their applications to optimal or model predictive control mainly for linear systems

The student will be able to:
- to analyse, model and solve an optimization problem of
discrete systems by a linear programming or a graph, by
applying relevant algorithms (simplex, usual graphs and
networks algorithms, combinatorial optimization)
- to model and to characterize: stationary Makovian processes with discrete state space (chains) and
continuous or discrete time, queuing systems, to analyse
their transient and stationary behaviours, to evaluate their
performances
- to model a discrete event systems by Petri nets and to analyse the properties by enumerative and structural approaches.
- to formalise and solve a quadratic criterion, nonlinear,
without or with constraints optimisation problem in the case
of systems with real variables
-to develop and design an optimal control law (LQG) for a
linear or linearized process.

Necessary prerequisites

Linear algebra ¿ Probabilities ¿ Dynamic systems (state concept) - Basic elements in logic systems and Petri nets.

Practical info

Location(s)

Toulouse

Research project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involves a team of 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its proj

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Computer science

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Object-Oriented Programming part:
. The principles of object-oriented programming: method call, classes.
.The application of those notions for programming connected objects

- Networks part:
. The basic concepts and techniques allowing interconnecting local area networks in the Internet: repeater, bridge, router
.the basic concepts and techniques allowing interconnecting LAN in the Internet : subnetting, CIDR, VLAN, VPN, applicative proxy, NAT
. the main protocols of the TCP/IP Internet architecture : UDP, TCP, IP, ARP/proxy ARP, ICMP, DHCP, RIP, OSPF, BGP

- Real-Time part:
.Designing real time applications.
. Understand and manipulate a real time kernel.

The student will be able to:
- Oject-Oriented Programming part:
. Develop java applications, using a modular object-oriented style.

- Networks part:
.Do architecture choices allowing to take into account requirements and constraints associated to a LAN interconnection.
. Do basic or complex addressing and routing schemas.
. Set up (administrate) Ethernet and IP networks in the basic and advanced interconnection contexts considered in the course.

- Real-Time part
.Set up a design methodology to respond to a specification.
. Design software architectures for real time applications.
. Ajust the tasks parameters to reach the expected performances.
-
- Simulate and analyze real-time applications performance

Necessary prerequisites

Software Engineering, introduction to networking, C programming

Practical info

Location(s)

Toulouse

Non-contractual information

Improving one's autonomy and building one's own professional project level 2 S

ECTS
4 crédits

Hourly volume
40h

Practical info

Location(s)

Toulouse

Non-contractual information

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

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

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Non-contractual information

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Systems Engineering processes

ECTS
5 crédits

Hourly volume
77h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
What are the engineering processes to develop a system, how they must be implemented and managed in companies, what are the associated standards.

The student will be able to:
- define, capture, analyze and express the stakeholders
- needs
- transform the needs into requirements
- define several logical and physical solutions from the needs, evaluate them and choose one manage development processes

Practical info

Location(s)

Toulouse

Object-Oriented and Real-Time Programming

ECTS
3 crédits

Hourly volume
50h

Introducing

Objectives

This module consists of two parts:
- The part on real time systems introduces real time systems, key concepts, applications, constraints, and teaches the programming of these systems using the services of real time operating systems.
-At the end of the object programming part, students will be able to produce C++ code from a UML class diagram with relationships, inheritance and polymorphism.

Practical info

Location(s)

Toulouse

Dynamics of structures and control

ECTS
4 crédits

Hourly volume
22h

Introducing

Objectives

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

Vibrations of mechanical systems and structures.

Controlling the articulated systems and flexible structures.

The global and local modelling of electromagnetic actuators.

Necessary prerequisites

Basis in electromagnetism, solid mechanics and control

Practical info

Location(s)

Toulouse

Mechatronic project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- power and information channels of mechatronic systems
- the place of system simulation activities in the design cycle (V design cycle) of complex systems
- the principle of data acquisition with computers

The student will be able to:
- Establish models suitable for various engineering tasks during the design of mechatronic systems.
- Implement models in a system simulation environment and perform validation and verification tasks associated to the V design cycle.
- Specify and conduct model-in-the-loop and software-inthe-loop activities for a complex system.
- Design the different elements of a simple data acquisition system
- Implement a graphical programming language dedicated to the acquisition (LabVIEW)
- Perform a security analysis
- Perform a lifecycle analysis with a dedicated software

Necessary prerequisites

Basics of mechanics, electronics, heat transfer, and automation.

Basic of algorithmic

Practical info

Location(s)

Toulouse

Research Initiating Project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involves a team of 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a projectif report and prepare a presentation in english for its project defense.

Practical info

Location(s)

Toulouse

Quality, security, environment and sports

ECTS
4 crédits

Hourly volume
61h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain the main principles and definitions of quality management, the importance of health and safety at work, how to assess and prevent risks, eco-design and life-cycle analysis.

The students will be able to develop their capabilities in eco design in a project related to mechatronics.

Sports:
The student will have to build a project with his team by:
- Taking into account everyone's skills,
- Seeking to enhance the strengths of each partner and compensate potential weaknesses.
- Analyzing the balance of power they will be confronted with.

Practical info

Location(s)

Toulouse

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

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

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Non-contractual information

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Non-contractual information

Digital signal acquisition architectures and Computed controlled systems

ECTS
4 crédits

Hourly volume
60h

Introducing

Objectives

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

The complete modelling from sensor to actuator is presented, associated with digital control technics. A specific labwork deal with the implementation of a complete chain of acquisition and digital processing in order to carry out the control of an actuator.

Practical info

Location(s)

Toulouse

Analog electronic system architecture

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Dimension and design of analog electronic functions of information processing (filtering,
amplification, automatic gain control, voltage controlled oscillators, modulators / demodulators AM and FM;
-Optimize the signal to noise ratio in each subset of an embedded system
-Modeling architectures for robust usage constraints (consumption, temperature to dissipate), the
thermal variations of the environment and dispersions characteristics of components

Practical info

Location(s)

Toulouse

Non-contractual information

[FRANCAIS] Analyse des systèmes complexes

ECTS
4 crédits

Hourly volume
50h

Introducing

Objectives

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

- Principles, difficulties and limits of the modelling of systems with multiple inputs and multiple outputs.
- Design and implementation of control of systems with multiple inputs and multiple outputs.
- Main possible and observable behaviors which can occur in the nonlinear systems (equilibrium states, limit cycles, complex behaviors) and their evolution by variation of the parameters.
- Basis of the theory of Lyapunov

The student will be able to:
- To apprehend the implementation of the control of a process with multiple inputs and multiple outputs.
- To begin the analysis of a nonlinear system by various techniques (qualitative, geometrical, and simulations)
- To lean on numerical analysis (Matlab©) to establish, confirm, validate, simulate and implement the theoretical results discussed during the courses.

Necessary prerequisites

- Cours de 2e année « Systèmes bouclés » (I2MAAU11)
- Cours 3e année IMACS « Modélisation et analyse des systèmes linéaires » (I3AMAU11)
- Cours 3e année IMACS « Commande des systèmes » (I3AMAU12

Practical info

Location(s)

Toulouse

QSE APS 4A GEI – 1

ECTS
4 crédits

Hourly volume
67h

Practical info

Location(s)

Toulouse

Non-contractual information

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

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

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Non-contractual information

Object-Oriented and Real-Time Programming

ECTS
3 crédits

Hourly volume
50h

Introducing

Objectives

This module consists of two parts:
- The part on real time systems introduces real time systems, key concepts, applications, constraints, and teaches the programming of these systems using the services of real time operating systems.
-At the end of the object programming part, students will be able to produce C++ code from a UML class diagram with relationships, inheritance and polymorphism.

Practical info

Location(s)

Toulouse

Device modeling and digital circuits architectures (reconfigurable computing)

ECTS
5 crédits

Hourly volume
55h

Introducing

Objectives

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

-the electronic device and digital electronic systems modelling
-the issue of the integration of electronic circuits
-the design and performance optimisation of digital architectures especially in frequency and power consumption. Ultra low power architectures will be studied for sustainable development.
- the technologies for green computing
- reconfigurable computing using FPGAs
-digital architectures dedicated to embedded Artificial Intelligence (AI)

The student will be able to understand the models of main electronics active devices and digital complex architectures and their optimisation for sustainable development The student will be prepared for the future technological breakout in their professional life.

Necessary prerequisites

Electrical circuits, electrostatics, analog and digital electronics, computer engineering

Practical info

Location(s)

Toulouse

Non-contractual information

Discrete and Continuous Systems Optimisation

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
- different approaches to analyse, evaluate the performance of discrete event systems through different
models (deterministic or stochastic, graphs) and to optimise them (linear programming)
- the optimisation methods for continuous systems :
-static (first and second order conditions)
- dynamic (dynamic programming)
- their applications to optimal or model predictive control mainly for linear systems

The student will be able to:
- to analyse, model and solve an optimization problem of
discrete systems by a linear programming or a graph, by
applying relevant algorithms (simplex, usual graphs and
networks algorithms, combinatorial optimization)
- to model and to characterize: stationary Makovian processes with discrete state space (chains) and
continuous or discrete time, queuing systems, to analyse
their transient and stationary behaviours, to evaluate their
performances
- to model a discrete event systems by Petri nets and to analyse the properties by enumerative and structural approaches.
- to formalise and solve a quadratic criterion, nonlinear,
without or with constraints optimisation problem in the case
of systems with real variables
-to develop and design an optimal control law (LQG) for a
linear or linearized process.

Necessary prerequisites

Linear algebra ¿ Probabilities ¿ Dynamic systems (state concept) - Basic elements in logic systems and Petri nets.

Practical info

Location(s)

Toulouse

Practical Work in Control

ECTS
3 crédits

Hourly volume
34h

Toulouse

Introducing

Objectives

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

This teaching illustrates all the 4th year automation courses (control of nonlinear systems, optimal control, numerical control, multi-variable control, graphs).

The student should be able to:
- Model/identify a system
- Synthesize a control according to a specification (performance) and implement it
- Know how to be critical on a command
- Know how to write a report

Necessary prerequisites

Analysis of non-linear systems - Multivariable systems - Peripherals - Numerical control - Acquisition chains and numerical control - optimal control - graph

Practical info

Location(s)

Non-contractual information

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

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

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

Non-contractual information

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Research project

ECTS
4 crédits

Hourly volume

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involves a team of 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its proj

Practical info

Location(s)

Toulouse

Energy management for embedded systems

ECTS
3 crédits

Hourly volume

Introducing

Objectives

- At the end of this module, the student will have understood and be able to explain (main concepts):
- The characteristics of the energy sources that can be used on embedded systems,
- The characteristics of quantities in electrical distribution networks
- Power converter architectures,
- The modeling of an electric motor/generator based on its coupled electrical and mechanical values.
- The operation of a transformer and its model.
- The structures and main characteristics of single-phase and three-phase AC-DC converters.
- The main chopper structures, their properties, reversibilities and their control.
- The principle of torque and/or speed regulation of a DC machine using a chopper.

The student should be able to:
- Analyze the energy needs of an on-board system and propose and size a solution,
- Use coupled electrical and mechanical equations to model an electro-mechanical system
- Analyze a mechanical system and identify the drive requirements, the type of converter that must be associated with the machine.
- Dimension the elements of an electrical energy conversion chain which allows to drive a given actuator.

Necessary prerequisites

General knowledge of electricity, alternating current, electrical circuits, analog and digital electronics as well as
mathematical tools (Fourier and Laplace transforms) and
the basics of automatic control (transfer functions and block
diagrams)

Practical info

Location(s)

Toulouse

Non-contractual information