INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

SEMESTER 9_T2 AE

Practical info

Location(s)

Toulouse

[FRANCAIS] Architecture électronique pour l'énergie

ECTS
5 crédits

Hourly volume
66h

Introducing

Objectives

General objectives: the goal of this UF is to know how to determine, size and produce the electronic architecture of an on-board system, select the components, under energy constraints: constraint of battery, autonomy, availability of power sources. energy¿ The UF therefore addresses
questions of the architecture of electrical energy converters, the installation of charging and battery
management systems, and architecture with multiple energy sources (advertising energy). The measurement of physical quantities (current, voltage, temperature, etc.) is
essential in an energy conversion or control chain for an electromechanical actuator. The UF also deals with the various sensor technologies and associated Electronic Instrumentation and Measurements.

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

- Design an electronic architecture of an embedded system under energy constraints
- Select appropriate electronic components for energy converter system
- Choose electrical energy storage solutions according to the associated constraints
- (Battery Management System / cell balancing
- Implement an ambient energy harvesting solution to design embedded systems energy self-sufficient
- Create a co-design HW / SW

Practical info

Location(s)

Toulouse

Embedded software and command for energy

ECTS
4 crédits

Hourly volume
48h

Introducing

Objectives

Objectives:
The electrical efficiency of electronic systems can be drastically improved by an appropriate selection of controls and algorithms whose objectives are to reduce as much as possible the activation of available resources of programable devices. The modeling of processing energy systems is central to evaluate their stability properties but also their dynamic performances which are key properties for the design of adequate control laws. One of the main difficulties is due to the nonlinear behavior and the commuting nature of all the processing energy systems which impose an important adaption of the control design methods. In this UF, control law design methods considering efficiency constraints are presented for static power electronics converters and for electrical motors. Some algorithmic aspects for the low energy programming associated to a wireless system are also developed.

Expected Competences:
- Modeling of static power electronic converters (Linearization around an equilibrium state, Nonlinear model, Switched model)
- Design and implementation of a control law for a static converter (linear and nonlinear control)
- Development of an embedded software reducing the energy consumption of the programable platform

Practical info

Location(s)

Toulouse

Technology, fabrication and industrialization of embedded systems

ECTS
5 crédits

Hourly volume
66h

Introducing

Objectives

General objectives: this UF addresses the integration, characterization and certification aspects of electronic systems. The students approach the various technologies of manufacturing and assembly of electronic systems, by addressing the tools of specification and industrial design (Electronic Computer-Aided Design). In addition, aspects of design methods and standards / conformities for the economical marketing of an electronic product are addressed. As the power components are subject to strong voltage and thermal constraints, issues of reliability and robustness are also addressed. Finally, the characterization aspects of various energy-related performance in electronic systems are dealt with impedance adaptation for optimal transfer of power to an antenna, EMC and ESD characterization, measurement of energy consumption.

This UF is deliberately based on an industrial approach and is carried out around the design of an electronic card prototype in an industrial workshop and then its characterization.

- Integrate an electronic system
- Design an e-card, under integration, energy, EMC, thermal constraints, etc.
- Reliability and robustness of the new power components
- Measure the performance of an electronic system (energy consumption, efficiency, CEM, impedance matching)
- Specify and carry out the certification process of an electronic system

Practical info

Location(s)

Toulouse

Electronic design for electrical vehicle

ECTS
5 crédits

Hourly volume
55h

Toulouse

Introducing

Objectives

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

- Advanced commands and actuators for electric vehicle powertrain
- Aechnologies and devices for electric vehicles
- Aevelop field oriented control for synchronous motor control
- Aropose and dimension electronic architecture for electromechanical actuator chains
- Analyze the failure modes of a motor driver and propose diagnosis and solutions to ensure safety

The student will be able to:
- Design and realize the command of electromechanical actuator (field oriented control for synchronous motor command).
- Design electronic architecture and embedded software for safe powertrain application, realized with real devices dedicated for automotive applications (microcontroller, smart power devices, sensors, system basis chip)

Practical info

Location(s)

Interdisciplinary project: smart energy manager for solar panel system

ECTS
5 crédits

Hourly volume
68h

Introducing

Objectives

The aim of the module is to mobilize all the skills in electronics, automatic control systems and embedded programming acquired during years 2,3,4,5 for an ambitious and complex engineering or R&D project. The students will be work with a huge autonomy. During this module, the students will work on an engineering project proposed by a industrial partner with the following steps:
¿ Team work (organization, communication planning)
¿ Project based on partner specification
¿ Research and analysis of solutions, positioning of the solution to the state-of-the-art
¿ Design, assembling, test of the proposed solutions
¿ Meeting points with the customer
¿ Planning and hardware supply management
¿ Reports and deliverables

Necessary prerequisites

I4AESE51 ¿ Energy management for embedded systems
I4AEAU11 ¿ Data acquisition and digital command
I4AEIM11 -Microcontroller programmation
I4AESE31 - Analog architectures for embedded systems
I5AEEE11 - Electronic architectures for energy
I5AELA11-Automation and embedded software for energy

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

Prescriptive Analytics

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course addresses several efficient models for processing data encountered in industrial combinatorial problems. These models are based on logical inference and mathematical optimisation techniques : constraint satisfaction problems (CSPs), boolean satisfiability (SAT)
and integer linear programming (ILP).
In the first part (CSPs), students are expected to understand and to be able to apply the main constraint propagation techniques and solving strategies, by hand, but are also initiated to programming tools that integrate general solvers (ex : CPLEX) during practical works.
In the SAT modeling part of this course, students are initiated to some propagation and heuristic solving techniques used in SAT solvers (DPPLL, Implication Graphs, Conflict Analysis, Two-watched litterals algorithm). Various applications problems such as allocation, graph colouring, scheduling serve as training examples for SAT encoding.
In the last part (MILPs), students will have to translate industrial problems into mixed-integer linear programs, then to solve them efficiently using branching algorithms or decomposition methods, embedded in existing tools such as CPLEX.

Necessary prerequisites

Algorithmics & programming (I2MIIF11, I2MIIF21). Fundamentals in Computer Science (I4IRIF11), Intelligent Systems (I4IRSD11)

Practical info

Location(s)

Toulouse

Software Defined Communication Infrastructure

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):

- the concepts related to the virtualization of network functions (in the NFV sense)
- the concepts related to network programming (in the SDN sense)
- the model of autonomic computing defined (among others) by IBM
- the views of real-world actors involved in a-large-scale project (application developer,-middleware operator, network operator)

The student will be able to:
- use an SDN network emulator (ContainterNET)
- use an SDN (Ryu) controller
- use a standardized MANO NFV (SON-EMU)
- develop a standardized VNF
- architect and implement solutions that take advantage of the concepts of virtualization of network functions and programmable networks, in the context of the realization of an SDCI
- apply and implement the model of autonomic computing to a problem of management of QoS in an SDCI

Necessary prerequisites

Networks Interconnexion - TCP/IP

Object oriented design UML (2. 0)

Object Oriented Programming - Java

Service-Oriented Architectures

Network Programming - TCP/IP

Practical info

Location(s)

Toulouse

Cloud Computing

ECTS
6 crédits

Hourly volume
69h

Practical info

Location(s)

Toulouse

Model driven engineering

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Modeling, evaluation and optimisation of networks and protocols

ECTS
4 crédits

Hourly volume
78h

Practical info

Location(s)

Toulouse

[FRANCAIS] Commande avancée et supervision

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Projet physique PTP_ISS

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Service Robotics

ECTS
6 crédits

Hourly volume
50h

Toulouse

Introducing

Objectives

At the end of this module, the student would be able to explain the main components of a robot service and to say in which way it differs from industrial robotics; he/she will know the main concepts in humanoid robotics and why it is difficult to control a walking robot. His/her knowledge will
include the main notions in jointed robotics: direct and inverse kinematic models, dynamic model of the robot, trajectory generation and stability of a bipedal robot.

The student is supposed to be able to model a jointed robot, to understand its technical components and to analyse the functioning of a service robot in its domestic or professional environment.

Necessary prerequisites

Matrix theory, Linear control

Practical info

Location(s)

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

Embedded Computer Architecture

ECTS
4 crédits

Hourly volume

Introducing

Objectives

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

- The principles and specificities of networks used in embedded systems in the automotive, avionics and connected objects,
- The specificities of operating systems and their main services (scheduling, memory, privileges,
etc.) for embedded systems
- The advantages and disadvantages of the different computer architectures used for embedded
systems
- The elements impacting the performance (computation, energy consumption, etc.) of a computer architecture and the methods to optimize them.

The student will be able to:
- Choose a network technology that meets the needs of an embedded system,
- Set up the support network of an embedded system,
- Deploy an operating system on an embedded architecture,
- Develop a driver within an operating system,
- Compare two embedded computer architectures in terms of performance,
- Choose a computer architecture adapted to the needs of an application.

Necessary prerequisites

C programming, computer organization, network, operating system

Practical info

Location(s)

Toulouse

Engineering methods

ECTS
4 crédits

Hourly volume
42h

Introducing

Objectives

Present the main principles of systems engineering and software engineering: concepts, methods and tools, to define and control the process development of a critical embedded system.

The student will be able to:
- apply these general competences to computer based embedded systems explain different methods and chose the best adapted
to develop a specific application.

Practical info

Location(s)

Toulouse

Dependability

ECTS
5 crédits

Hourly volume
68h

Introducing

Objectives

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

The basic concepts of dependability and main methods and techniques for obtaining and validation of the safety.

The student will be able to:
- apply these general competences to computer based embedded systems
- explain different methods and chose the best adapted to develop a specific application.

Necessary prerequisites

Discrete event systems, Propositional Logic,

Practical info

Location(s)

Toulouse

Interdisciplinary Project

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will be able to:
- Implement and apply agile management according to the agile method in order to create a product,
- Select and interweave a set of interdisciplinary technical skills in order to develop a critical embedded system,
- Search autonomously and be able to critique technical solutions for which he/she does not have prior knowledge in order to meet requirements specific to critical embedded systems,
- Design and build a product deployed on a heterogeneous and communicating embedded architecture guaranteeing performance properties,
- Define needs, requirements and architecture when designing a product
- Communicate in an interdisciplinary context and to work together with actors with heterogeneous skills,
- Adapt the writing and presentation of scientific results according to the audience (client, decision maker, evaluator, general public) and through various media (presentation, website, report, synthesis, poster).

To express themselves correctly in English, using a concise and precise style respecting the conventions of genre in writing as well as orally

Practical info

Location(s)

Toulouse

Prescriptive Analytics

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course addresses several efficient models for processing data encountered in industrial combinatorial problems. These models are based on logical inference and mathematical optimisation techniques : constraint satisfaction problems (CSPs), boolean satisfiability (SAT)
and integer linear programming (ILP).
In the first part (CSPs), students are expected to understand and to be able to apply the main constraint propagation techniques and solving strategies, by hand, but are also initiated to programming tools that integrate general solvers (ex : CPLEX) during practical works.
In the SAT modeling part of this course, students are initiated to some propagation and heuristic solving techniques used in SAT solvers (DPPLL, Implication Graphs, Conflict Analysis, Two-watched litterals algorithm). Various applications problems such as allocation, graph colouring, scheduling serve as training examples for SAT encoding.
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Necessary prerequisites

Algorithmics & programming (I2MIIF11, I2MIIF21). Fundamentals in Computer Science (I4IRIF11), Intelligent Systems (I4IRSD11)

Practical info

Location(s)

Toulouse

Software Defined Communication Infrastructure

ECTS
4 crédits

Hourly volume

Introducing

Objectives

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Necessary prerequisites

Networks Interconnexion - TCP/IP

Object oriented design UML (2. 0)

Object Oriented Programming - Java

Service-Oriented Architectures

Network Programming - TCP/IP

Practical info

Location(s)

Toulouse

Cloud Computing

ECTS
6 crédits

Hourly volume
69h

Practical info

Location(s)

Toulouse

Model driven engineering

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Modeling, evaluation and optimisation of networks and protocols

ECTS
4 crédits

Hourly volume
78h

Practical info

Location(s)

Toulouse

[FRANCAIS] Commande avancée et supervision

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Projet physique PTP_ISS

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Service Robotics

ECTS
6 crédits

Hourly volume
50h

Toulouse

Introducing

Objectives

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include the main notions in jointed robotics: direct and inverse kinematic models, dynamic model of the robot, trajectory generation and stability of a bipedal robot.

The student is supposed to be able to model a jointed robot, to understand its technical components and to analyse the functioning of a service robot in its domestic or professional environment.

Necessary prerequisites

Matrix theory, Linear control

Practical info

Location(s)

Software engineering and service oriented architectures

ECTS
4 crédits

Hourly volume
41h

Introducing

Objectives

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

- Software project lifecycle
- The challenges of software development
- Project management methods, particularly the agile method
- Service oriented architecture
- Resource oriented architecture (RESTful)
- Microservice architecture

The student will be able to:
- Control the conduct of a software development project with a team by following the scrum agile method
- Perform requirement analysis: expression, analysis and transformation into technical requirements
- Design and develop a service oriented architecture
- Implement Web services SOAP and Rest
- Develop a service composition (orchestration) via BPEL
- Develop microservices
- Understand and implement a RESTfull API

Necessary prerequisites

Algorithmic, Object oriented programming (Java), Object oriented design (UML), XML, and XML schema

Practical info

Location(s)

Toulouse

Reliability and model-checking

ECTS
4 crédits

Hourly volume
42h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain the main principles of systems engineering and software engineering: concepts, methods and tools, to define and control the process development of a critical embedded system.

The student will be able to:

- apply these general competences to computer based systems
.explain different methods and chose the best adapted to develop a specific application.

Necessary prerequisites

Petri Nets, Communicating Automata, formal Logic, Graph theory

Practical info

Location(s)

Toulouse

[FRANCAIS] Analyse descriptive et prédictive

ECTS
4 crédits

Hourly volume
56h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- the different problems associated with data study (in exploratory data analysis and in machine learning)
- the main concepts and algorithms allowing to solve those problems
- the main existing libraries

The student will be able to:
- analyze the requirements of the data processing
- set up the most efficient algorithms
- use the algorithms that are implemented in the main existing libraries
- adapt and develop his/her own algorithms
- analyze and explain the results of those algorithms
- program in Python and R languages

Necessary prerequisites

Algorithms, data structures, computational complexity, programming, optimization, supervised machine learning (basic knowledge), statistics and probability (basic knowledge), programming

Practical info

Location(s)

Toulouse

Infrastructure for massive data processing

ECTS
4 crédits

Hourly volume
61h

Introducing

Objectives

At the end of this module, the student will understand and be able to explain the concepts and techniques related to the main pillars that have to be managed by an IT service provider, in terms of:

- physical infrastructure (network, storage , computing) ;
- organizational and data management (allocation of storage , ...);
- computation services of such data (based on calculation models like map reduce, etc.).

The student will be able to:

1) With regard to physical infrastructures
- design and deploy a network architecture adapted to a big data oriented service, using advanced network technology (network virtualization, optimization protocols, etc.);
- dimension and deploy a physical storage infrastructure aimed at receiving massive amounts of data;
- assess and deploy the computing power required to process massive data, based on the latest technologies for processors, such as virtualization.

2) With regard to the organization and data management
- design and implement tools to organize data within the physical infrastructure;
- provide appropriate interfaces for access to such data;
- choose a data organization adapted to the constraints of treatment (offline versus real-time processing);

3) With regard to the data processing services
- provide facilities for analyzing data and extract value added information (e.g., learning, trends).

Necessary prerequisites

Networks
Operating systems
Databases
Algorithmic and programing

Practical info

Location(s)

Toulouse

[FRANCAIS] Projet SDBD

ECTS
4 crédits

Hourly volume
52h

Toulouse

Introducing

Objectives

At the end of this module, the student should have understood and will be able to explain:

- The objectives of an Artificial Intelligence and Big Data project
- The methodological and technological choices retained and developed to respond to a specific project

The student should be able:
- To create a software chain for the collection, storage and processing of massive data,
- to argue about the choices made,
- to evaluate the proposed solution.

Necessary prerequisites

Descriptive and Predictive Analysis, Big Data Infrastructures

Practical info

Location(s)

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
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-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

Module élève ingénieur (UE PETAR dispensée UPS)

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse