EMBEDDED SYSTEM COURSES

Integrated circuit design	7 credits	104h
Technology, fabrication and industrialization of embedded systems	6 credits	74h
Autonomous embedded systems design	5 credits	71h
Sensor network : design and networking	5 credits	
Human Resources Management and Group Work	6 credits	75h

Integrated circuit design

ECTS
7 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
104h

Presentation

Description

Programme (detailed contents):

* Starting from a real industrial application, the students will specify an embedded electronic system.
* Using the previous specification, the students will design the system on chip and realize the software/hardware partitioning.
* The students will design HW system architecture (digital and analog blocks, interfaces, power sources) taking into account the performances of the system (robustness, power consumption, frequency). The validation will be done by simulation and integrated circuit implementation (IP block).

Organization:

* Courses and labs
* Project based learning
* Link with English courses. The final report and the oral presentation are given in English.

Objectives

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

* MOS characteristics
* CMOS analog and digital function performances (consumption, efficiency, Signal-to-noise ratio, operating frequency , ...)
* The different simulation modes to characterize analog and digital circuits performances
* Design and optimization of advanced integrated systems
* Co-design of SW/HW complex systems

The student will be able to:

* Specify an advanced electronic system including digital, analog, RF circuits and interfaces
* Set up a design methodology (computer aided design) to respond to a specification
* Design full custom CMOS circuits basis (IP blocks) of SoC.
* Simulate CMOS circuits performances with professional tools (Cadence)

Useful info

Place

Toulouse

Technology, fabrication and industrialization of embedded systems

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
74h

Presentation

Description

Programme (detailed contents):

* modeling techniques and power circuit components
* integration techniques and design (schematic packages in accordance with standard JDEC, manufacture of PCBs in accordance with the standard norm NFC93-713, reflow process, bonding techniques)
* industrialization constraints (BOM, FMEA, BTF, traceability, components définitions)
* awareness of standards (DBT, TERN, CE, RoHS, WEEE) and qualification processes
* analysis techniques and metrics for monitoring quality of an industrial process

Organization:

This teaching approach based on voluntary industry is made around the design of two prototypes in industrial workshops:

• a prototype electronic board assembled on a line classe4 Industrial CMS

• SoP prototype, produced in a clean room for micro-electronic chip part and then assembled as an MCM (hybrid indirect) consisting of mixed SMD/chips carried and connected on different substrates (ceramic, epoxy FR4, flex)

Objectives

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

• how to write a specification of industrialization of an embedded system (BOM, Gerber files, BTF, FMEA, ..)

• how to define classes technology of a printed circuit board (PCB rigid, flexible, hybrid)

• how to route the signals in terms of constraints in line with the aspects heat dissipation and signal integrity

• how to define the type of mounting card (single / double layer, size Class)

• how to comply with different standards (NF 93-713, RTTE, DBT, RoHS, WEEE)

• how to set up a monitoring process quality (ISO17025)

• How to estimate the reliability of the assembly (standard FIDES)

The student will be able to know all stages of manufacturing, design methods and standards / compliance of an electronic product ready to sell.

Useful info

Place

› Toulouse

Autonomous embedded systems design

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
71h

Presentation

Description

Programme (detailed contents):

Due to embedded system constraints linked to the application, two applications are detailed:

• complete design an autonomous mobile robot able to move and communicate with other robots.

• design of an automotive application (body control) with sensors, microcontrollers, smart power actuators, communication bus, LCD display, system basis chip, in partnership with NXP.

The themes are:

- Management / Storage / energy recharging.

- Automotive electronics modern power boards, computers communication bus, LCD display, system basis chip

- Architectures and protocols of the various buses (wired and wireless)

- Architectures multi-source voltage (interface and translation of logic levels)

- Motor control

- Instrumentation and reconfigurable architectures for sensor signal conditioning

- components to ensure safety and robustness

Organization:

Mixed between lectures and Project based learning

Lectures are made by different industry stakeholders, each with a special skill and working in order to give students the latest advances in automotive electronics.

Projects allow students to work in a very close conditions that they will find in the industry.

For the design part of a mobile robot, it is ensured by leading researchers in the field of embedded electronics.

Objectives

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

- Energy Management:

  * architectures converters (DC-DC, LDO, Band-Gap ...)

  * Storage and charging architectures (Lipo, Li-ion ...)

* Management of low-power modes of a microcontroller

- Interfacing:

  * between logic levels (strong currents, voltage levels, EMC, thermal protection, ...)

  * between the microcontroller and peripherals based on the waveform of the current• with power actuators (smart MOS)

-Communication:

  * protocols: I2C, SPI, CAN, OneWire

  * RF protocols: XBee, 868MHz, 433MHz RFID

- On board intelligence:

  * Reconfigurable digital and analog architectures (3 bit microcontroller, FPAA)

- Display:

  * Automotive Dashboard

  * Screens / touchscreens

- Safety and robustness:

  * analysis of safety

  * System basis chip, power supply supervision

  * Watchdogs, error and fault diagnosis

  * EMC requirements

The student will be able to devise from specifications all the subsystems architectures and choose components to assume a design complies with the specifications (battery and electronics management, connection of selected cards and constraints for microcontrollers programming).

Note that analog design will be provided on

FPAA.

Useful info

Place

Toulouse

Sensor network : design and networking

ECTS
5 credits

Presentation

Description

Programme (detailed contents):

This course is composed of :

1) lectures :

20 lectures (1.25h each)

2) practical labs :

They consist of :

* *Project 1* : 7 lab sessions (2.75h each)

The students have to implement three different sensors (one accelerometer, one photoresistor, and one pyroelectric infrared sensor). Then, they have to design, size and test an electronic circuit dedicated to process the sensor signal.

* *Project 2* : 7 lab sessions (2.75h each)

On a microcontroller platform : setup transfer protocols through a sensor network to exchange information to a GSM mobile terminal.

Objectives

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

About the sensors part :

* the way various sensors operate (optronic, thermal, mechanical, acoustic ...),
* the operation of these sensors and the associated signal conditioning.

About the communication between sensors part:

Wireless communication technologies and sensor networks, internet of things (IOT), machine to machine communication (M2M).

Useful info

Contacts

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Human Resources Management and Group Work

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
75h

Presentation

Objectives

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

Human Resource Management

Aims and organisation of a Human Resources position, job analysis and forecasting, recruiting, work motivation, skills, salary, training, career management, conflict mitigation, work contract

Social Psychology

Groups, what they are, their influences and dynamics

The student will be able to analyse a group situation

Pre-requisites

None

Place

Toulouse

Useful info