



DUT in Computer Science Embedded Systems Track

Objective

To train computer specialists :

- Able to design and implement information processing systems
- Skilled in embedded systems :
 - ↳ Mobile and embedded architectures (smartphones, microcontrollers, FPGA ...)
 - ↳ Basic and real-time operating systems
 - ↳ Wireless networks
 - ↳ Real-time constraints
- Able to easily integrate data-processing/electronics development teams

Course of study

- Computer Science (900h) : Algorithmics and Programming Languages, Hardware Architecture - Operating systems - Networks, Web - Internet - Mobility, Database management systems, Data analysis and design and application development
- Cross-curricular subjects (900h) : Mathematics, Economics - Management – Organisation - Law, Expression and Communication, English
- Mentored group projects (300h) : designed for an approach to work as a senior technician in a company or organisation. Its objective is to develop the future technician's professional skills through putting into practice their knowledge and know-how
- 11-week internship in a company or organisation

Computing skills

- **Algorithmics and programming :**
 - Object-oriented Technologies** : class libraries, design patterns, use of APIs (JDBC, DOM)
 - Frameworks** : iOS, DOM, SAX
 - Graphical Interfaces** : Swing, iOS
 - Complex data structures** : containers (STL C++), collections, trees, graphs
 - Web development** : PHP (Symfony), HTML5, CSS, XML
 - Languages** : C/C++, Java, Objective C
- **Systems architectures :**
 - Memory management and optimisation** : C and assembler programming, OS installation and parameter settings on minimal platforms (Linux, FreeRTOS, Contiki)
 - Specific development tools** : cross compilation, In Situ programming and debbuging, loaders, IP core integration on FPGA
 - Development platforms** : 32-bit ARM microcontrollers (Cortex Mx, Cortex A8, DSPIC), FPGA

- **Operating systems:**
 - OS internal features :** Linux/C-C++ interfaces, shell commands, file systems, users and process management, scheduling
- **Electronics for embedded systems :**
 - Digital and analogic interface circuits :** electrical levels in circuit communications (static and dynamic behaviors of digital signals), electronic circuit analysis and implementation
 - Datasheet analysis :** characteristics, consumption ; Prototyping.
- **Device drivers :**
 - Device datasheet analysis :** protocol layer structuring
 - Interfaces :** low-level (SPI, I2C) and advanced interfaces (USB, CAN).
 - Implementation :** on processors and microcontrollers, with or without OS
- **Mathematics and computing for signal processing :**
 - Information digitization :** sampling, spectra
 - Transforms :** Fourier and discrete Fourier transforms, Laplace and Z transforms
 - Direct application to digital processing :** filtering, PID control
 - Architectures and algorithms :** DSP applications
- **Networks :**
 - Fundamentals of networks :** terminology, infrastructures, hardware interconnection, communication management rules, OSI and TCP/IP architectures, standard protocols (Ethernet, ARP, ICMP, IP, TCP, HTTP).
 - User aspects :** network configuration, applications (email, web browsers), TCP/IP networks (configuration, routing, filtering) and Internet installation and configuration with Linux (Web Apache, DNS, DHCP).
 - Wireless communication :** IEEE 802.15.4, Bluetooth (BLE), wireless sensor networks (6LowPAN, Zigbee).
- **Relational databases :**
 - Introduction to the relational database model and query languages SQL2/SQL3 :** practical experience on Oracle (direct, integrated, and procedural mode). Access to databases in Java/PHP/Objective C.
- **Application production methodology :**
 - Project management :** AGILE (SCRUM) and traditional (V-model) methods. Planning and monitoring projects in information systems, versioning, collaborative tools
 - Modelling :** UML (Modelio tool). Software life cycle (analysis, design, testing, deployment, maintenance)

Cross-disciplinary skills

- **Mathematics :** discrete mathematics (graph theory, formal language automata), linear algebra, analysis and digital methods, probabilities, stochastic methods
- **Expression and communication classes in French :** Written and oral expression, educating students to enter the workforce (job applications, interviews, etc.), putting into context (teamwork, meetings, reports, etc.)
- **English language :** English for communication and professional purposes, scientific and technical English
- **Project management :** Planning and follow-ups of projects related to information systems
- **Economics, management, organisation, law :** Business economics (modelling functions, strategies) and today's economic problems, Law related to information technologies, Account management with interpretation and analysis of balance sheets and results, management software, Costs, provisional and financial budgets.

Embedded platforms used

- Development board ARM Cortex M3 and Cortex M4 (STM32), Cortex A8 (AM3517)
- Altera FPGA Cyclone II, processor NIOS II
- Android et iOS platforms
- Raspberry Pi
- TI SmartRF06 and SensorTag development board (CC2650 wireless MCU)