



ENSEA

Beyond Engineering

Computer Science and Systems

Graduate/Master Program

ENSEA – Semester 9 IS - French-Taught

Computer Science and Systems

ENSEA - IS 3rd Year Academic Track

Level	Second year of Master's Degree/Graduate/Semester 9		
Period	Fall semester (September to January)		
Language of tuition	French		
ECTS	30		
Courses	Code	Course	ECTS
	IS_1	Digital Circuit Design [Composed of:]	5
	IS_3431	Digital circuit design	
	IS_2	System on Chip [Composed of:]	5
	IS_3432	System on Chip	
	IS_3	Systems and Networks [Composed of]	5
	IS_3433	Systems and Networks	
	IS_4	Algorithmics [Composed of:]	5
	IS_3434	Algorithmics	
	IS_5	Software Engineering [Composed of:]	5
	IS_3435	Software Engineering	
	IS_3450	Conferences	
	SH-3EME	Humanities [Composed of:]	5
	DSH_3000	Responsible and sustainable management of human resources in a complex environment	
	DSH_3060	English	
DSH_3061	FLE (French for foreigners) or Spanish or German		

Computer Science and Systems

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IS_1 Digital Circuit Design (5 ECTS)

IS_3431 Digital circuit design (Lectures: 16h / Tutorial classes: 8h / Lab: 44h)

This course presents the digital circuit design methodology for information processing

Starting from the definition of the specifications. The different types of circuits (ASIC, CPLD, PLA, FPGA) are presented. The tools for computer assisted design are presented as well as the languages of description and modeling of hardware such as VHDL, VHDL-AMS, and some notions of Verilog. Some aspects of advanced VHDL modeling techniques are presented such as subprograms and file access. VHDL description and modeling applications of some circuits, then their simulation, synthesis and implementation on FPGA-based target boards will be explored. This course also offers the opportunity to acquire knowledge of in-depth analysis of system structures and organizations, digital signal processing oriented (DSP), particularly DSP Sharc. The architecture of the processor is presented, with the associated functionalities: operations with fixed and floating point; contribution of parallelism, interest of the pipeline; management of interruptions; inputs / outputs; DMA communications; serial links... Development tools used for programming the DSP mixes C language and assembler: extensions in C, mixing C and assembler for advanced programming, parameter passing, stack management.

IS_2 System on Chip (5 ECTS)

IS_3432 System on Chip (Lectures: 14h / Tutorial classes: 4h / Lab: 44h)

The complexity of digital systems is growing rapidly causing an increase in the cost of development. Today's applications integrate on a single chip a complete system (SoC) with several processing cores (CPU, DSP, ASIC, Microcontrollers) associated with IP blocks, I/Os and memory elements. The conception of these systems requires new design and global validation methods before its realization (joint software/hardware design).

- Organization of a design process for a SoC
- Hard and soft IP concepts: performance and flexibility
- System Description Languages (SystemC)
- Design of reusable macros and their integration
- Checking of complex systems
- Reconfigurable systems (RSoC)
- FPGA-SoPC approach (System-on-Programmable Chip)
- Processor cores in SoPC: NIOS, MicroBlaze, ARM, LEON, etc.
- Communication bus: Amba (ARM), CoreConnect (IBM), AVALON (Altera).

IS_3 Systems and Networks (5 ECTS)

IS_3433 Systems and Networks (Lectures: 8h / Tutorial classes: 4h / Lab: 56h)

The objective of this module is the knowledge of mechanisms and low-level software processes used in modern systems. Two levels are explored: a machine level, and a network level. At the machine level, the following elements are studied:

- Kernel functions, memory management, operation of system calls, startup.
- Notion of process. Notion of task. Allocation. Scheduling.
- Communication between tasks, resource management, IPC, message queue. Memory allocation, mapping, interruptions, I/O, module programming core.
- Disk management. Management of blocks and inodes, cache management, file search, links
- File management. Opening, sharing, locking, pipes.
- Implementation on i80x86 platform.

At the network level, the following points are presented:

- TCP/IP network bases, data exchange protocols (HTTP)
- Common data formats (JSON, XML).
- REST architecture, Web API frameworks (Swagger).
- Deployment of software solutions in distributed environments.

These skills are used for the realization of a multiplayer videogame on TCP/IP networks.

IS_4 Algorithmics (5 ECTS)

IS_3434 Algorithmics (Lectures: 10h / Tutorial classes: 6h / Lab: 48h)

The main objective of this course is the acquisition of skills for finite-state problem solving using algorithms. This subject is incrementally explored, and, in each case, illustrated by numerous examples. The course begins with the presentation of the recursive approaches, which allow to solve the most common problems, such as the search for the best combination. Then, the tree-level formalism generalizes this first approach. This makes it possible to better understand the processes involved, but also to design more efficient algorithms in terms of time of calculation and memory consumption. The tree-level formalism is then extended to graphs, which allows to solve more complex problems, such as flow problems. Finally, these notions are brought together around formalisms allowing the description and the efficient resolution of all finite-state problems.

The advanced algorithms require significant computing resources. In order to conduct them in the most efficient way, the parallelization approaches of the treatments are presented. It begins with the use of SIMD processor instructions, where a single instruction can process multiple data. Then, the parallelization on several processors is taught, as well as all the issues related to multi-thread programming: synchronization, signals, resource sharing, etc. These principles will also be presented for the operation of treatment units massively parallel, like GPUs. Finally, the techniques for the distribution of calculations in data centers are presented, with a special focus on solutions based on the map-reduce paradigm and its implementation with the tools of the Hadoop system.

These skills are then exploited for the realization of artificial intelligence within a video game.

IS_5 Software Engineering (5 ECTS)

IS_3435 Software Engineering (Lectures: 12h / Tutorial classes: 8h / Lab: 48h)

This course starts with the presentation of formal tools used for the design of software solutions. This includes the realization of various elements such as the conception of specifications and the design of diagrams. This course will be based first and foremost on the UML formalism to achieve these objectives. Then, recaps in object-oriented programming will be proposed in these formal contexts, allowing to make the link between abstraction and implementation. The most common design schemes will also be taught, both in a formal way with UML and in concrete way with Java and C++. Finally, the main IT tools for the organization and realization of software will be presented: compilation systems, version, validation and project management.

The course also presents an introduction to project management. On the software engineering side, notions such as constraints on a project, V-shaped software development cycle, quality, software modeling methods and the associated tools will be explored. On the project management side, several fundamental concepts will be presented: deadline management, cost management and team management. A final assignment concludes this part so that the students are put in real-life situations. Students will gather in teams, process the development that is proposed and thus will put into practice the concepts presented in course. Presentations and exchanges between students and professors will conclude this second part. All these notions will be applied with the realization of a major project, together with the implementation of a complete development environment.

IS_3450 Conferences (Lectures: 10h / Tutorial classes: -h / Lab: -h)

The lectures are delivered by professionals of the field. The themes vary from one year to the next depending on the evolution of techniques.

SH_3EME Humanities (5 ECTS)

DSH_3000 Responsible and sustainable management of human resources in a complex environment

(Lectures: 16h / Tutorial classes: 6h / Lab: -h)

The course presents the evolution of organizations in a complex environment (team management, corporate culture in a multicultural context, professional project through the dynamics and management of evolutions). It emphasizes the strategic role of human resources management in a CSR context (Quality of Life at Work - OHS) in order to prepare engineering students (guided by the 26000 standard) for their role as project managers, project leaders or employees of a project team.

It introduces the notions of labor law that are essential for engineers (employment contracts, expatriation, work environment in the company) by integrating the social and societal concerns of the company.

The practical courses allow, through an edutainment approach (or in the form of a serious game):

- to implement an HRM that values responsibility and ethics (Remuneration, Training, Skills management, Health and Safety at work).
- Identify good practices to implement a CSR policy.

DSH_3060 English (Lectures: -h / Tutorial classes: 24h / Lab: -h)

The objective of the third-year courses is to make the students able to work in English and have a good command of the language.

The goal is achieving a professional use and to reach, at least, a B2 level requested to obtain the degree.

Two third-year options are grouped together for English courses. Level groups can be formed. The students will be able to work on different aspects of life professional (communication in different settings, in the office, abroad, in seminars, through writing, orally, case studies...), by carrying out work groups and putting in practice the knowledge they have acquired throughout their training.

DSH_3061 FLE (French for foreigners) (Lectures: -h / Tutorial classes: 24h / Lab: -h)

The main goal of this class is training the foreign students through communication fundamentals for everyday life, proposing them an introduction to French culture and civilization and more advanced knowledge in order to work in a French company during the final internship period.