DIGITAL SYSTEMS PROGRAMME WINTER SEMESTER (S5)

MODULES	TITLE	ECTS	
HUMANITIES			
	French as a foreign language	2	P2
	English	1	P3
	International management	2	P4
	Conferences on human sciences		
	Conferences on Technical subjects		
TECHNICAL			
	Optimization and Machine learning –Neural Networks	3	P5
	Detection-Estimation	1	P6
	Information theory and channel coding	2	P7
	Advanced image processing and analysis	2	P8
	Integrated systems and high level synthesis	2	P9
	Advanced computer architectures	2	p10
	Multi-processor architectures	2	P11
	Real-time UML/SysML	1	P12/13
	System on Chip design	1	P14
	Source coding	1	P15
	Pattern recognition	1	P16
	Wireless communications	2	P17
PROJECTS			
	Technical project	5	P18
		30	

Course title :	**FRENCH**
Course Coordinator :	Nathalie Caradec nathalie.caradec@enssat.fr
Type of module Compulsory module Prerequisite: placement test for level group	
Course duration : 30hrs	
Module components /Types of Courses • Practical courses in small group Dialogues- role play –variety of teaching material through the media and digital technology	
1 ECT	
Work load: In class studying	
Content: CEFR French levels are used on the four skills speaking – listening-reading and writing • Level A1-A2 can introduce him/herself, can ask and answer questions about personal details such as where he/she lives, people he/ she knows, and things he/she has. Can interact in a simple way provided the other person talks slowly and clearly. • Level B1-B2 Can understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Can deal with most situations likely to arise whilst travelling in an area where the language is spoken. Can produce simple connected text on topics which are familiar or of personal interest. Can describe experiences and events, dreams, hopes & ambitions and briefly give reasons and explanations for opinions and plans. Common European Framework of References : CECRL (Cadre Européen Commun de Références pour les Langues)	
Learning outcomes: Development of the different skills according to the level.	
Assessment - Written assignment - Oral assignment	
Language of instruction: French	
Additional information	

❒2nd/☑3rd year / DIGITAL SYSTEMS

Course title **ENGLISH**	
Coordinator Claire LE PAGE claire.le-page@enssat.fr	
Type of module (compulsory module, required Elective module, elective module) COMPULSORY	
Course duration	30 hrs
Course components /Types of Courses (lectures, practical course, Practical courses in small groups lab, tutorial, internship, …)	
1 ECT	
Work load -In class studying 30 hrs -Student managed learning: 20 hrs	
Content This course is designed to teach students at an "independent level" to communicate effectively in English at the B2 /C1 level on general topics.	
Learning outcomes: At the end of this course students will be able to • Do presentations • Debate on topical issues • Interact with a degree of fluency which makes communication with a native speaker possible • Write reports on a wide range of interests. • Understand the main ideas of complex texts on concrete or abstract topics • Understand extended speech or conferences	
Assessment: continuous assessment - Written assignment ☑ - Oral assignment ☑	
Language of instruction ENGLISH	
Additional information: B1 level is a prerequisite	

❐2nd/☑3rd year / COMPUTER SCIENCE

Course title	**INTERNATIONAL MANAGEMENT**
Course coordinators :	Karine HENRY/Claire LE PAGE karine.henry@enssat.fr; claire.le-page@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	COMPULSORY
Duration of module	30 hrs
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)	Practical courses in small groups
2 ECTs	
Work load	-In class studying 20 hrs -Student managed learning: 10 hrs
Content This course is designed to acquire some fundamental knowledge on international and intercultural management	
Learning outcomes: At the end of the course students will be able to	Explore a theoretical approach of intercultural dimensions Develop cross cultural awareness Experience a serious game Develop soft skills in management
Assessment: continuous assessment	- Written assignment ☑ - Oral assignment ☑
Language of instruction	ENGLISH
Additional information: B1 level is a prerequisite	

ENSSAT LANNION

❒1st / ❒2nd/☒ 3rd year / ❒Master of photonics

Course title **Optimization and tools for Machine Learning and Neural Networks**	
Course coordinator Pascal Scalart Pascal.scalart@enssat.fr	
Type of module (compulsory module, required Elective module, elective module) Required elective module	
Course duration 46 hrs	
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lectures (22h), Exercises (6h) and Lab (18h)	
3 ECTS	
Work load -In class studying -	
Content The first part of this lecture presents the fundamental concepts within optimization, such as mathematical modelling, optimality conditions, convexity, Lagrangean approach and Karush, Kuhn and Tucker (KKT) conditions. Basic theory and methods for linear and nonlinear optimization under equality and inequality constraints will be presented. The second part on operational research presents all the optimal methods and techniques geared towards finding the best choice by seeking optimum estimators in the least squares sense. The key results will be covered using elementary concepts in probability, stochastic processes and process modeling. It is strongly linked to systems engineering. We first describe the Wiener filter and the resolution of the Wiener–Hopf linear system of equations for wide-sense stationary signals. We then discuss about the linear prediction of the value of a signal from its previous measurements on a finite number of points. The last part is devoted to the theory of adaptive and kalman filters which are commonly used in practice. In the lab, student will have to work on one of the following projects: (i) adaptive equalization for digital communication systems, (ii) adaptive acoustic echo cancellation in data networks, or (iii) images classification with convolutional neural networks.	
Learning outcomes - Introduction to Optimization o First order and 2nd order differential, Convexity o Algorithms (steepest descent, Newton, quasi-Newton, ..) o Optimization under equality constraints: Lagrange theory o Optimization under inequality constraints: Karush Kuhn Tucker - Operational Research o Parametric modelling o Linear Prediction theory o Wiener filters o Adaptive filtering (LMS, NLMS, Newton, RLS algorithms) o Kalman filters	
Assessment - Written assignment for the Optimization part - Laboratory Report for the Operational Research part	
LANGUAGE OF INSTRUCTION	ENGLISH

❒1st / ❒2nd/☑3rd year / ❒Master of photonics

Course title: **Detection- Estimation**	
Course coordinator: Prof. Kacem CHEHDI Kacem.Chehdi@enssat.fr	
Type of module (compulsory module, required Elective module, elective module) compulsory module	
Course duration 1 semester	
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lecture : 12 hrs	
1 ECT	
Work load -In class studying: 12 hrs -Student managed learning : 10 hrs	

Content:
• General introduction and definitions
• Criteria for assessing the performances of estimators
• Construction of the estimators
  ○ Definition of cost functions.
  ○ Construction of free structure estimators
  ○ Construction of imposed structure estimators and applications
• Detection and applications.	

Expected learning outcomes: Mastery of the estimation methods necessary for the design of optimized decision-making systems. **Description:** The principal estimators are presented after introducing the different risk functions. The conditions of use and the performances of the different estimators are specified. Application examples integrating so-called "intelligent" systems are given. Some problems and solutions corresponding to real cases treated in our laboratory within the framework of industrial partnerships are presented and analyzed. **Bibliography:** - B. PICINBONO, Random Signals and Systems, Prentice-Hall, 1993. **- P.Y. ARQUES, Décisions en traitement du signal, Masson, 1982** - M. ROSENBLATT, Random Processes, Oxford press, 1962.	
Assessment Written assignment	
Language of instruction ENGLISH	
Additional information	

ENSSAT LANNION

❒1st / ❒2nd/☑3rd year / ☑Master of Electronics (SISEA)

Course title	**Information Theory and Channel Coding**
Course coordinator	Claude Cariou claude.cariou@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	compulsory module, required
Course duration	16 hrs
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)	lectures
2 ECTs	
Work load	-In class studying 16 hrs -Student managed learning 11 hrs
Content	This course first addresses the foundations of Information Theory, seen through Shannon's most important theorems (source coding theorem, channel coding theorem, information capacity theorem). In a second part, the most common families of error control coding over noisy channels are described and analyzed.
Learning outcomes	• At the end of the course, the student can understand the fundamental limits of communication systems in the presence of noise; • The student is able to propose practical solutions and implementations in terms of error control coding for application in data transmission or storage.
Assessment	- Written assignment
Language of instruction	FRENCH or ENGLISH
Additional information	

❒1st / ❒2nd/☑3rd year / ❒Master of photonics

Course title: **Advanced image processing and analysis**	
Course coordinator: Prof. Kacem CHEHDI Kacem.Chehdi@enssat.fr	
Type of module (compulsory module, required Elective module, elective module) Compulsory	
Course duration 1 semester	
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lecture: 16hrs, Practical course: 4hrs	
2 ECTS	
Work load - In class studying: 20 hrs - Student managed learning : 20 hrs	

Content:

I- Introduction
II - Image filtering and restoration
III - Characterization of textured images
IV- Compression

Expected learning outcomes:

Mastery of the implementation stages of decision-making systems by image analysis: optimized processing of degraded images according to objective criteria, characterization of 2D random processes (higher order statistics) and compression.

Description:

This course consists of three parts:

The first part is dedicated to the treatment of images degraded by blur or and noise. The different degradation models are presented. The classical and advanced methods adapted to each model are described and analyzed. The different objective evaluation criteria to assess the quality of the restored images are analyzed.

The second part deals with the characterization of the image pixels for their classification. Deterministic and probabilistic methods are presented.

The last part is dedicated to image compression. The classical and advanced methods are detailed. The different standards are also presented.

This course is completed by a session of practical course. Most of the problems examples solved correspond to real cases treated in our laboratory within the framework of industrial partnerships.

Bibliography :

- B. PICINBONO, Random Signals and Systems, Prentice-Hall, 1993.
- M. ROSENBLATT, Random Processes, Oxford press, 1962.
- S. HAYKIN, Adaptive filter theory, Prentice Hall, 1991.
- S. BELLINI et al., Blind deconvolution: polyspectrum and Bussgang techniques, pp. 251–263, Elsevier, 1986, Biglieri ed.

Assessment Written assignment	
Language of instruction ENGLISH	

❒1st / ❒2nd/☒3rd year / ☑Master of electronics

Course title:	**Integrated systems and high-level synthesis**
Course coordinator:	Emmanuel Casseau Emmanuel.casseau@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	Compulsory module
Course duration	1 semester
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)	Lecture : 18 hrs, lab : 6 hrs
2 ECTs	
Work load	-In class studying: 24h -Student managed learning : 16h
Content	• Hardware technologies and applications • System on Chip (SoC): architectural solutions, hardware platforms • Design flow and SoC design methodologies • Signal flow graph, algorithmic transformations (retiming, pipelining, parallelization, associativity, distributivity) • Principle of high level synthesis • High level synthesis steps (scheduling, allocation, binding, optimizations) and associated techniques
Learning outcomes	At first, this course aims to present what is a system-on-a-chip (SoC) and the principles of SoC design. The methodologies as well as the main used tools are presented. Then the goal is to present a method of designing specific digital circuits aimed at automating the transition from a high-level description of an application to its hardware description while allowing to explore the design space (mainly throughput versus area). This method is called high level synthesis. The targeted applications are signal processing based ones. Typically, the application is represented in the form of a signal flow graph on which formal transformations will be applied in order to optimize its hardware implementation according to certain criteria (surface, flow, etc.). The various steps and techniques (transformations, component selection, scheduling, binding) of the high-level synthesis process are detailed.
Assessment	- Written assignment
Language of instruction	ENGLISH
Additional information	

ENSSAT LANNION

❒1st / ❒2nd/■3rd year / ☑Master of Electronics

Course title:	**Advanced Computer Architecture**
Course Coordinator:	Professor Daniel CHILLET daniel.chillet@enssat.fr
Type of module: (compulsory module, required Elective module, elective module)	Compulsory module
Course duration:	1 semester
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) • Lecture: 12 hrs • Exercise: 2 hrs • Lab : 6 hrs	
2 ECTs	
Work load -In class studying: 20 h -Student managed learning: 15 h	

Content
• Introduction
• Reminders on basic computer architecture (pipeline, cache memory)
• Advanced techniques for high performance processors
  ○ Data dependencies, pipeline stall
  ○ Registers rename
  ○ Branch prediction
  ○ Out of order execution
  ○ Simultaneous multi-thread
  ○ VLIW processors
  ○ Superscalar processor
  ○ Epic model
  ○ Toward multi-processors	

Learning outcomes The aim of this courses is to explain how the processors have evolved since the first model, also called Von Neumann processor. The course discusses why and how these processors deliver high performance computing capability and which techniques are implemented in these processors to provide more and more performance, year by year. Several techniques are highlighted and explained with several examples. From this course, the students will be able to understand how recent processors work and they will also be able to optimize their code in order to exploit the processors performances.	
Assessment - Written assignment ○ Coefficient **2** - Oral assignment	
Language of instruction ENGLISH	

ENSSAT LANNION

❐1st / ❐2nd/☒3rd year / ❐Master of photonics

Course title:

Multi-processor architectures

Course coordinator:

Guillermo Andrade

Type of module
(compulsory module, required
Elective module, elective module)

Compulsory module

Course duration

1 semester

Course components /Types of
Courses (lectures, practical course,
lab, tutorial, internship, …)

Lecture : 10hrs, lab : 10hrs

2 ECTS

Work load

-In class studying: 20hrs
-Student managed learning : 10hrs

Content

This courses starts with the evolution of modern CPU architectures toward a massive parallel architecture. This is illustrated with Intel CPU evolution. Basics aspects of threads programming on C language are presented and followed by a introduction of SIMD operations using SEE and AVX intel instruction set and overview of OpenMP directives for multi-core programming, Second part of this courses is center on Graphic Processor Unit (GPU): architecture evolution and tools for programming with particular attention to NVIDIA CUDA a *de facto* standard on massive parallel programming using GPU. At the end, an overview of portables tools for programming GPUs and multi-cores CPU are showed with a final discussion about performance considerations and best practices.

- Basics on parallel machine
  - CPU architectures
  - Threads
  - Intel SSE and AVX instructions set
  - Multi-core programming with OpenMP
- GPU and CUDA
  - GPU architectures
  - GP-GPU languages
  - CUDA programming
  - PyCUDA
- OpenCL and portable tools
  - Concepts
  - PyOpenCL
  - AMD HIP, OpenACC, OpenMP 4.0 C++ AMP, Python NUMBA
- Performance considerations

Learning outcomes

After this courses, you will able to:

- program modern CPU in C or C++ to achieve high performance using theirs parallel capabilities,
- program massive parallel codes using GPU in CUDA language or with others portables tools,
- apply good practices for identify performance bottlenecks and in some cases, avoid there by design.

Assessment

- Written assignment

Language of instruction
ENGLISH
Additional information

ENSSAT LANNION

❒1st / ❒2nd/☒3rd year / ❒Master of photonics

Course title:
Real-time UML/SysML
Course coordinator: Benoît Vozel benoit.vozel@enssat.fr
Type of module (compulsory module, required Elective module, elective module) Compulsory
Course duration 1 semester
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lecture : 16 hrs
1 ECT
Work load - In class studying: 16 hrs - Student managed learning : 16 hrs

Content

- Basics of object-oriented modeling in real-time programming by means of UML/SysML diagrams as well as their interrelations
  - The Use Case Diagram
    - Use Cases, Actors, Associations, Relationships between Actors, Relationships between Use Cases
  - The Class Diagram
    - Objects Classes (Notation, Attributes, Multiplicities, Operations, Visibility Markers, Class Variables and Class Operations)
    - Associations (Binary Associations, N-Ary Associations)
    - Association Classes
    - Aggregations (Shared Aggregations, Compositions)
    - Generalizations (Inheritance, Classification)
    - Abstract Classes vs. Interfaces
    - Data Types
    - Creating a Class Diagram (Generalizations, Associations and Aggregations)
    - Code Generation
  - SysML
    - Block Definition Diagrams
    - Internal Block Diagrams
  - The State Machine Diagram
    - States and State Transitions
    - Types of States
    - Types of State Transitions
    - Types of Events
    - Composite States (The Orthogonal State, Submachines, Entry and Exit Points, The History State)

    - Sequence of Events
    - Difference Between a Passive Object and an Active Object
- The Sequence Diagram
    - Interaction Partners
    - Exchanging Messages
    - Messages
    - Combined Fragments (Branches and Loops, Concurrency and Order, Filters and Assertions)
    - Further Language Elements (Interaction References, Gates, Continuation Markers, Parameters and Local Attributes, Time Constraints, State Invariants)
    - Creating a Sequence Diagram (The Connection between a Class Diagram and a Sequence Diagram, Describing Design Patterns)
- The Communication, Timing, and Interaction Overview Diagrams
- The Activity Diagram
    - Activities
    - Actions (Event-Based Actions, Call Behavior Actions)
    - Control Flows
    - Object Flows
    - Partitions
    - Exception Handling
- Structuring Models
    - Packages
    - Importing Elements/Packages
- UML Extension Mechanisms
    - Stereotypes and Profiles
    - Applying Stereotypes of a Profile
- Object Constraint Language (Overview, Logic, Container Data Structures, Functions in OCL)
- Illustration of an active object framework for embedded systems

Learning outcomes

This course, oriented model-based software development, aims at providing a solid foundation and deep understanding of the most essential object-oriented modelling concepts in real-time programming. Three inseparable aspects of the UML diagrams are detailed jointly, including the notations of the language elements, their meaning and the way to use them efficiently in a software life cycle. SysML relationship with UML is explained and illustrated. Much emphasis is spent on illustrative examples of hard real-time constrained systems with increasing complexity, breathing life into the underlying theory from requirement specification over system design and implementation (even automatic generation of executable code) to maintenance and software evolution.

Assessment

- Written assignment

Language of instruction

ENGLISH

Additional information

❒1st / ❒2nd/☒ 3rd year / ❒Master of Electronics

Course title: **System on Chip Conception**	
Course coordinator:	Robin Gerzaguet robin.Gerzaguet@enssat.fr
Type of module (compulsory module, required Elective module, elective module) Required elective module	
Course duration:	18 hrs
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lectures (6h) and Lab (10h)	
1 ECT	
Work load -In class studying	
Content This lecture presents the key aspect associated to System On Chip (SoC) design. SoC are platforms that embedded a processor and hardware accelerator, jointly with inputs/outputs and dedicated co-processors. SoC are now massively used in industry (phones, hardware platforms, and many devices…) and cannot be reduced to the simple concatenation of general-purpose processor (GPP) and hardware accelerators. It is necessary to propose new design flow that considers the advantages of these platforms. Besides that, as the space design is wide (both in hardware and software) it is necessary to optimally distribute the process in the hardware part and the software part: this is called the Hardware/software (HW/SW) partitioning and is matter of importance to benefit from the SoC special architecture. Finally, an introduction on embedded Linux and how to map hardware accelerator at the operating system level is presented. In the labs, the students will use a Zybo board with Vivado in order to create a signal processing application and see the performance difference between a pure software approach and a HW/SW approach	
Learning outcomes - SoC architectures and specificities - SoC design flow - Hardware/software partitioning - Embedded Linux - Vivado tools and Zybo board.	
Assessment - Written assignment	
Language of instruction ENGLISH	

ENSSAT LANNION

❒1st / ❒2nd/☑3rd year / ☑Master of Electronics (SISEA)

Course title:	**Source Coding**
Course coordinator:	Pascal Scalart pascal.scalart@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	compulsory module, required
Course duration:	26 hrs
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)	lectures 14 hrs lab 12 hrs
2 ECTS	
Work load	-In class studying 26 hrs -Student managed learning 17 hrs
Content Source coding aims at compressing data (analog or digital) to provide an efficient binary representation of these data (i.e. a high compression ratio) while preserving the essential information they convey (i.e. a low distortion). Source coding are used to transmit or store data such as speech, image or video data, and is strongly related to other specific applications such as image classification, speech recognition, face recognition, etc.	
Learning outcomes At the end of the course, the student can • Identify the different families of audio/speech and image/video codecs; • Analyze and characterize the performances of several quantization techniques: scalar quantization (uniform and non-uniform), vector quantization; • Understand the properties of the main audio codecs for use in fixed (xDSL, DVB) and mobile (GSM, 3G, 4G/LTE) networks; • Understand the basis of perceptual audio coding: psychoacoustics and quantization noise shaping; • Identify the main functions embedded in a H.264-like codec (inter- and intra-frame prediction; motion estimation/compensation; analysis-by-synthesis codecs).	
Assessment	- Written assignment (Lab report)
Language of instruction	FRENCH or ENGLISH

ENSSAT LANNION

❒1st / ❒2nd/☑3rd year / ❒Master of photonics

Course title:	**Pattern Recognition**
Course coordinator:	Prof. Kacem CHEHDI Kacem.Chehdi@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	Compulsory module
Course duration	1 semester
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)	Lecture : 12 hrs
1 ECT	
Work load	- In class studying: 12 hrs - Student managed learning : 10 hrs

Content:

- Introduction
- Definition of similarity metrics
- Classification methods (non-hierarchical and hierarchical)
  - Supervised Methods
  - Semi-supervised methods
  - Unsupervised methods

Expected learning outcomes:
Mastery of supervised and unsupervised classification methods for the implementation of so-called "intelligent" decision-making systems.

Description:
The criteria for measuring the similarity or dissimilarity between objects or shapes represented by a set of features are defined. Then, the different parametric and non-parametric methods using learning phases are explained. Finally, semi-supervised and unsupervised methods are detailed. The advantages and constraints of each method or algorithm are highlighted. Problems and solutions corresponding to real cases treated in the laboratory within the framework of industrial partnerships are presented and analyzed.

Bibliography:

- Anderberg M.R. Cluster analysis for applications. 359p. Academic Press, New York, London. 1973.
- Benzécri J.P. L'Analyse des données. Tome 1: La Taxinomie. 615p. Dunod, Paris. 1973.
- Diday E., Lemaire J., Pouget J., Testu F. Eléments d'analyse des données. 462 p. Dunod, Paris. 1982.

Assessment	Written assignment
Language of instruction	ENGLISH
Additional information	

ENSSAT LANNION

❒1st / ❒2nd/☒ 3rd year / ☑Master of Electronics

Course title **Wireless communications**	
Course coordinator Robin Gerzaguet Robin.Gerzaguet@enssat.fr	
Type of module (compulsory module, required Elective module, elective module) Required elective module	
Course duration:	16 hrs
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lectures (8hrs) and Lab (8hrs)	
2 ECTS	
Work load -In class studying	
Content This lecture presents the constraints and specificities of wireless transmissions. Several key physical aspects are presented such as digital baseband model of carrier frequency transmissions and deterministic and probabilistic multipath channel models. The second part of the lecture is dedicated to signal processing techniques dedicated to wireless transmissions and focus on the physical layer: the mathematical model of Orthogonal Frequency Division Multiplexing (OFDM) is presented jointly with the core aspect of the waveform. Several standards based on OFDM are finally introduced (WiFi, LTE-4G, expected 5G…) In the lab, the student will implement an OFDM receiver in Matlab and then test their code in a real time experiment on Software defined radios (USRP e310)	
Learning outcomes - Digital baseband model - Multipath channel model (WSS) - Rayleigh and Rice channel model - Orthogonal Frequency Division Multiplexing (OFDM) - WiFi and LTE standards	
Assessment - Written assignment	
Language of instruction ENGLISH	

❒1st / ☒2nd/❒3rd year / ❒Master of photonics

Course title:	**Technical project**
Course coordinator:	Emmanuel Casseau Emmanuel.casseau@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	Compulsory
Course duration	1 semester
Course components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)	Lecture : h, lab : h
5 ECTS	
Work load	-In class studying: 0 h -Student managed learning : 140 hrs
Content	• Design project in electronics/embedded systems/signal processing, as a team or individually.
Learning outcomes	As part of this project, students have to put into practice their technical and technological know-how acquired throughout their studies in electronics/embedded systems/signal processing to carry out a design project spanning 4 months, as a team or individually. These projects are also the opportunity to develop written and oral communication skills.
Assessment	- Project report + oral assessment
Language of instruction	ENGLISH
Additional information	