## Introduction

Communication and information processing systems have developed and become widespread in recent years. These technological systems, which are becoming more and more efficient, are now reaching a high level of complexity.
In order to understand the challenges of a constantly evolving information society, it is necessary for a generalist engineer to acquire a set of basic knowledge in the field of information sciences and techniques, as well as a set of scientific tools and methods that will enable him/her to apprehend the challenges to come.
The objective of the UE STI is to provide this global understanding of information processing techniques and their implementation. The level aimed for is sufficient to implement the elementary methods, interact with specialists in the field or to orientate oneself later on in a career linked to the associated disciplinary fields of Electronics and Signal Processing.

## Semester

S05

S06

## Programme

STI tc0 : Autonomous work
STI tc1 : Electronic Systems
STI tc2 : Signal Processing
STI tc3 : Analog-to-Digital Conversion

## Learning Outcomes

- Master the scientific bases of signal processing and electronics
- Be able to understand the main functions present in an information processing system
- Master the elementary techniques associated with these functions
- Master the technological principles involved in the realisation of information processing systems

## Employment Sectors

## Requirements

Electrical laws, analog filtering, operational amplifiers, binary coding, logic, functional analysis, complex numbers, elementary probability

## Assesment

Weighted mean: STItc0: 15%, STItc1: 40%, STItc2: 40%, STItc3: 5%

## Option Website

## Additional Information

## *AUTONOMIE STI*

## AUTONOMY

**Lecturers:** Ian O CONNOR, Alberto BOSIO, Julien HUILLERY

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 12.0 | Study : 0.0 | Project : 0.0 | Language : FR

### Objectives

The autonomous work of UE STI aims to facilitate the assimilation of concepts learned during the courses of Electronic Systems (AF STItc1) and Signal Processing (AF STItc2).
Through the theoretical study of methods to answer a given problem and their implementation in a simulation environment, the objective is to introduce students to a fundamental professional practice in engineering sciences.

Keywords : Theoretical analysis, Simulation, LTSpice, Matlab-Simulink

### Programme

- Regarding Electronic Systems, the autonomous work consists of the study in simulation - with the help of the LTSPICE software - of systems treated on paper during the tutorial sessions. This work is done in the first part of the semester, as the tutorials progress.
- Regarding Signal Processing, the autonomous work consists of a mini-project where it is asked to fully study a method allowing to answer a given problem. The work goes from the theoretical study of this method to its validation in simulation under Matlab-Simulink and mobilizes all the knowledge and know-how acquired during the supervised sessions. It is carried out in the second part of the semester.

### Learning outcomes

- Understand proposed methods for solving a problem.
- Know how to implement these methods with a simulation tool.
- Know how to analyse simulation results.

### Independent study

Objectifs :

Méhodes :

### Core texts

### Assessment

The work is assessed by an individual oral presentation at the end of the semester. (Final mark = 100% know-how / Know-how = 100% final exam).

## *SYSTÈMES ÉLECTRONIQUES*

## ELECTRONIC SYSTEMS

**Lecturers:** Ian O CONNOR, Alberto BOSIO

| Lecturers : 14.0 | TC : 14.0 | PW : 6.0 | Autonomy : 2.0 | Study : 0.0 | Project : 0.0 | Language : FR

### Objectives

The evolution of electronic systems is linked to Moore's Law according to which the complexity of integrated circuits doubles every eighteen months. In order to be able to grasp the complexity of current systems and understand their evolution, it is necessary to know the basics of electronic technology.
The objective of the "Electronic systems" course is therefore to provide the engineering student with the scientific and technological bases necessary for the understanding of the functioning of electronic systems and their evolution as well as for the design of complex systems composed of circuits for processing information represented as analog as well as digital signals.

Keywords : PN junction, CMOS transistor, analog circuits, digital circuits, processors.

### Programme

- Introduction to electronics
- MOS transistor
- High frequency modelling, presentation of the CMOS amplifier
- Detailed study of the MOS inverter
- Digital circuits, combinatorial logic. Boolean algebra and Karnaugh tables. Digital circuits, sequential logic
- Microprocessor architecture

### Learning outcomes

- Be able to understand the scope of the field of electronics: from device to processor.
- To be able to describe the evolution of microelectronic systems.
- Know how to identify circuit design methods and techniques.

### Independent study

Objectifs : Learn more about the topics covered in tutorials (TD).

Méhodes : Perform electrical simulations with a reference simulator (LTSPICE) to analyse the operation of devices and circuits.

### Core texts

Rousseau Eric, *PSPICE : MÉTHODOLOGIE D'UTILISATION ET TECHNIQUES AVANCÉES*, DL, 2007
Dusausay Serge *COMPRENDRE L'ÉLECTRONIQUE PAR LA SIMULATION : 43 CIRCUITS SIMULÉS & RAPPELS DE COURS*, DL, 2000
Poitevin Jean-Marc*ÉLECTRONIQUE ANALOGIQUE ET NUMÉRIQUE : AIDE-MÉMOIRE* , DL, 2008

### Assessment

Score = 90% "savoir" + 10% "savoir-faire" ("savoir" score = final test of 2 hours without document / "savoir-faire"score = 50% TP1 report + 50% TP2 report).

## *TRAITEMENT DU SIGNAL*

## SIGNAL PROCESSING

**Lecturers:** Julien HUILLERY, Gérard SCORLETTI

| Lecturers : 12.0 | TC : 14.0 | PW : 4.0 | Autonomy : 2.0 | Study : 2.0 | Project : 0.0 | Language : FR

### Objectives

Signal processing consists of all the techniques used to describe the acquisition, storage, modification, coding and transmission of information. Faced with the mass of the signals that need to be processed, often in real time, technological systems of great complexity have invaded our society. In response to current challenges, powerful scientific methods have been developed to manage such complexity. The mastery of these methods becomes inescapable in the practice of the engineer whatever the field to which it is destined. The objective of this course is to present the preliminary bases for the acquisition and mastery of these methods and to illustrate them by their application.

Keywords : Deterministic and random signals, Analog and digital signals, Time domain and frequency domain analysis, Fourier and Laplace transforms, Analog and digital filtering, Sampling, Fast Fourier transform, Generator filters

### Programme

1) Modelling and characterizing a signal: time domain and frequency domain analysis
2) Modelling and characterizing a system: convolution and filtering
3) Autocorrelation and intercorrelation for deterministic signals
4) From analog signals to digital signals
5) Digital Filtering
6) From deterministic signals to random signals

### Learning outcomes

- Be able to analyse a signal in the time and frequency domains.
- Be able to sample a signal.
- Be able to design analog and digital filters.
- Be able to model a signal.

### Independent study

Objectifs : Follow an engineering approach by mobilizing knowledge and know-how acquired during the AF.

Méhodes : Solve a practical and original signal processing problem by applying the numerical methods and tools acquired during the course.

### Core texts

G. Scorletti, *TRAITEMENT DU SIGNAL*, Polycopié de cours, SDEC – École Centrale de Lyon, 2021
E. Tisserand, J.F. Pautex et P. Schweitzer *ANALYSE ET TRAITEMENT DES SIGNAUX*, Sciences sup. Dunod, 2004
E.W. Kamen et B.S. Heck*FUNDAMENTALS OF SIGNALS AND SYSTEMS WITH MATLAB*, Pearson Prentice Hall, 2007

### Assessment

Final mark = 90% knowledge + 10% know-how (Knowledge = 80% final exam + 20% continuous assessment / Know-how = 100% continuous assessment)

## *CONVERSION A/N POUR LES SYSTÈMES AUDIO*

## ANALOG TO DIGITAL CONVERSION

**Lecturers:** Cédric MARCHAND, Laurent BAKO

| Lecturers : 0.0 | TC : 0.0 | PW : 4.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

### Objectives

Through the study of analog-digital conversion, this AF illustrates the complementarity of electronics and signal processing for the design of information management systems. The operation, simulation and then realization of an analog-digital converter "Sigma-Delta" will be studied. This converter has an excellent behaviour with respect to the quantization error inherent to the analog-to-digital conversion. These good performances justify its important use in the audio field for consumer applications such as CD recorders. In this AF, we focus on highlighting the link between the theoretical and technical aspects that accompany the design of an electronic system.

Keywords : Analog-to-digital conversion, electronic systems, Sigma-Delta modulator, digital signal, quantization, signal-to-noise ratio, filtering

### Programme

- 1st session (BE 2 h): uniform conversion (Presentation of analogue / digital conversion; Principle and properties of uniform analog / digital conversion; Practical Activity (1h): Simulation and study of a uniform converter with matlab)
- 2d session (BE 2 h): Conversion Sigma-Delta (Principle and properties of the Sigma-Delta converter; Practical Activity (1h): Simulation and study of a Sigma-Delta converter under matlab / simulink)
- 3d session (TP 4 h): Electronic realization of a Sigma-Delta modulator (Design of the electronic circuit carrying out a Sigma-Delta modulation; Observation and analysis of signals in the space of time and frequency)

### Learning outcomes

- Know how to describe the theoretical principle of the Sigma-Delta converter.
- Be able to conduct a simulation of the system under Matlab-Simulink.
- Being able to design an electronic circuit making a Sigma-Delta modulator.
- Be able to analyse signals in time and frequency.

### Independent study

Objectifs :

Méhodes :

### Core texts

Sangil Park., *PRINCIPLES OF SIGMA-DELTA MODULATION FOR ANALOG-TO-DIGITAL CONVERTERS.*, Rapport Technique Motorola APR8.
Joshua Reiss *UNDERSTANDING SIGMA–DELTA MODULATION: THE SOLVED AND UNSOLVED ISSUES.* , Journal of the Audio Engineering Society, 2008

### Assessment

Grade = 100% practice (practice grade = 1/3 1st session + 1/3 2nd session + 1/3 3rd session)