



# **ENSEA Syllabus 2019**


## **Year 1 & 2**

## **ENSEA First Year Syllabus**

*Last year of Bachelor or Undergraduate studies*


Teaching in either semester (S5 and S6) is organized in 6 modules (or teaching units). Each module can be divided in several courses.

<b>LANGUAGES_S5</b> <b>Fall Semester</b> <b>Undergraduate/Junior</b>	<b>LANGUAGES</b>	<b>4 credits</b> <b>Continuous exams</b> <b>English: 50%</b> <b>Second-language: 50%</b>
<p>This course aims at providing a communication tool both professional and general, develop autonomy in different skills (written and oral components). The goal is to obtain B2 as minimum level.</p> <p>Specific workshops take place all year: professional and technical English, presentations, resume writing, report writing, interview test, TOEIC, TOEFL preparations</p>		
<b>Prerequisite:</b> None		


<b>DSH_1101</b>	<b>English</b>	<b>Language</b> 
	<b>Tutorials: 26</b>	
<p>The goal is to enable the students to be autonomous in their use of English language in a professional and general environment in the different skills (oral &amp; written expression and understanding.) The goal is to obtain B2 as minimum level at the end of the cursus.</p> <p>English classes will take place as elective workshops. Each student chooses a 13-week-workshop among four suggested by the teaching team. These workshops allow the combination of cultural and linguistic aspects linked to the countries, whose language is studied, technical and/or artistic aspects. Workshops on developing the necessary skills to obtain external certifications will also be suggested. Evaluation is made using continuous exams inside each workshop.</p>		


<b>DSH_1102</b>	<b>German</b>	<b>Language</b>
	<b>Tutorials: 24</b>	
<p>The goal is to answer the needs and interests of future engineers. Lectures will not only focus on linguistic aspects, but also help to discover the culture and work in German countries. Communication competencies are focused on, students learn the language by using it. They are trained in speaking, listening, reading and writing in daily-life situations. Students are encouraged to prepare official language certificate internationally recognized, such as Goethe Institute certification.</p>		

<b>DSH_1103</b>	<b>Spanish</b>	<b>Language</b>
	<b>Tutorials: 24</b>	
<p>The main objective is to allow the students to acquire fundamental knowledge needed for a fluent daily life communication and to develop communication competencies required in professional environment. Lectures are also the place to introduce to Hispanic culture. Activities and documents are therefore focused on Hispanic sociocultural specificities. Teachings are divided in competencies levels (beginner, intermediate, advanced) in order to follow each student in their individual learning according to their prior knowledge. The major objective is to introduce or confirm the morphosyntactic and phonological notions. Communication competencies in the CECRL framework (speaking, writing and understanding) are organized in learning chapters aiming at developing pragmatic learning outcomes: presentation, description, discussion.</p>		



	<b>French for international students</b>	<b>Language</b> 
	<b>Tutorials: 24</b>	
<p>This course allows the students to learn the French language along with its culture.</p>		



<b>AUTOMATION_S5</b> <b>Fall Semester</b> <b>Undergraduate/Junior</b>	<b>Control Engineering &amp; Energy I</b>	<b>5 credits</b> <b>Lab: 40%</b> <b>Final exam (3h): 60%</b>
<p>This course aims at explaining the fundamental notions used to study linear systems and to introduce alternating energy production. The study of linear systems relies on prior knowledge and recalls basic notions applied for single-variable reduced order systems. The study of electrical systems in steady state allows the definition of the alternating current electrical machines principles, alternator, induction motor, while explaining the different types of power plants used in energy production.</p>		
<b>Prerequisite:</b> None		

<b>DA_1401</b>	<b>Linear Systems</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 10</b>	<b>Lab work: 12</b>
<p>This course deals with the application of linear systems theory to engineering. It recalls the basic knowledge of single-input-single-output (SISO) continuous-time linear systems, open-loop and closed-loop (feedback) control.</p> <ul style="list-style-type: none"> <li>- Laplace and Fourier Transforms</li> <li>- Continuous-time linear systems</li> <li>- Transfer function and diagrams (Bode, Nyquist, Black-Nichols)</li> <li>- Order 1 and 2 systems</li> <li>- Identification</li> <li>- Stability, precision, speed</li> <li>- PID (Proportional-integral-derivative) controllers</li> </ul>		


<b>DA_1402</b>	<b>Alternating energy production</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 12</b>	<b>Lab work: 12</b>
<p>This course deals with the basic knowledge in alternating electrical energy production and transport. General principles of alternating machines are given: alternator, induction motor.</p> <ul style="list-style-type: none"> <li>- Ferromagnetism</li> <li>- Steady state electrokinetics</li> <li>- Polyphase electrical systems</li> <li>- Forced flux machine model, transformer</li> <li>- Electrical energy production, alternators</li> <li>- Induction motor</li> <li>- Electrical safety rules</li> <li>- Power plants</li> </ul>		


<b>COMPUTER_S5</b> <b>Fall Semester</b> <b>Undergraduate/Junior</b>	<b>Digital systems &amp; Computer</b>	<b>5 credits</b> <b>Lab: 30%</b> <b>Computer exam (2h): 30%</b> <b>Final exam (2h): 40%</b>
This course aims at explaining the theoretical and practical concepts in the area of digital processing architectures. Theoretical notions are related to logics, digital representations, algorithmics and hardware architecture synthesis that allow their implementation. Practical notions are dedicated to the learning of programming language such as C language (algorithms) and VHDL (hardware description).		
<b>Prerequisite:</b> None		


<b>DITN_1501</b>	<b>C Language</b>	<b>Language</b>  
<b>Lecture: 6</b>	<b>Tutorials: 28 (BYOD)</b>	
This course deals with procedural programming concepts, addressing basic algorithmic notions and implementing them in C language. Hypothesis on hardware architecture linked to C language are also discussed. Basic development notions on microcontroller are given.		
<ul style="list-style-type: none"> <li>- Understanding software and hardware roles inside a computer</li> <li>- Basic algorithms (test, loop)</li> <li>- C language, library conception</li> <li>- Memory management</li> <li>- Programming a microcontroller</li> </ul>		


<b>DITN_1502</b>	<b>Digital electronics I</b>	<b>Language</b>  
<b>Lecture: 10</b>	<b>Tutorials: 10</b>	<b>Lab work: 16</b>
This course deals with the basic concepts of digital systems. Combinatory logic, counters and logic circuit conception using VHDL are presented. Basic notions in reconfigurable circuits are also discussed. Systemic conception is developed.		
<ul style="list-style-type: none"> <li>- Combinatory systems</li> <li>- Reconfigurable architectures and development process associated</li> <li>- Average-complexity functions synthesis using combinatory structures</li> <li>- Latches, counters</li> <li>- Sequential logic time notions</li> </ul>		

<b>SIGNAL_S5A</b> <b>Fall Semester</b> <b>Undergraduate/Junior</b>	<b>Mathematics &amp; Signal I 1A</b>	<b>6 credits</b> <b>Lab: 20%</b> <b>Tutorials: 20%</b> <b>Final exam: 60% (2x2h)</b>
<p>This course aims at providing the mathematical basic notions used in signal processing and linear systems. At the outcome, the student will be able to</p> <ul style="list-style-type: none"> <li>- Understand the role of Hilbert spaces in signal representation</li> <li>- Decompose a discrete time signal in a basis suitable to shift-invariant linear filter (DFT)</li> <li>- Compute the Z-transform of a discrete-time signal and apply it to random processes.</li> </ul>		
<b>Prerequisite:</b> None		


<b>DST_1201</b>	<b>Fourier analysis I 1A</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 10</b>	<b>Tutorials (BYOD): 2</b>
<p>Time and frequency characterization of signals and discrete-time filters</p> <ul style="list-style-type: none"> <li>- Hilbert space, duality</li> <li>- Shift-invariant linear operators characterization</li> <li>- Convolution product, impulse response</li> <li>- Convolution operator diagonalization, DFT</li> <li>- Projection, approximation, compression</li> <li>- Signal representation, power and energy concepts</li> </ul>		

<b>DST_1202</b>	<b>Complex analysis</b>	<b>Language</b> 
<b>Lecture: 10</b>	<b>Tutorials: 6</b>	<b>Tutorials (BYOD): 4</b>
<ul style="list-style-type: none"> <li>- Holomorphic functions, Harmonic functions, Cauchy formula</li> <li>- Cauchy integrals, residue theorem</li> <li>- Applications: generating function, Discrete-time Fourier Transform, Z-transform</li> </ul>		


<b>DST_1203</b>	<b>Probability</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 10</b>	<b>Tutorials (BYOD): 2</b>
<p>Experiment modelisation, classical distributions and random processes.</p> <ul style="list-style-type: none"> <li>- Bayesian probability</li> <li>- Random vector</li> <li>- Discrete-time random process</li> <li>- Markov chain</li> </ul>		


<b>DST_1204</b>	<b>Mathematics Lab</b>	<b>Language</b> 
		<b>Lab work: 16</b>
This lab work will illustrate the different notions seen in this entire module.		


<b>ELECTRONICS_S5A</b> <b>Fall Semester</b> <b>Undergraduate/Junior</b>	<b>Electronics 1A</b>	<b>6 credits</b> <b>Lab: 33%</b> <b>Final exam: 66% (3h)</b>
<p>This course aims at providing the basic notions in understanding electronic systems. At the outcome, the student will be able to</p> <ul style="list-style-type: none"> <li>- Identify functional blocks in a scheme or integrated component and define their characteristics and performances</li> <li>- Design an electronic function from specifications, prototype it and verify that it meets the specifications using both CAD (Computer-aided design) and measurements.</li> </ul> <p>The student has to acquire the following knowledge and skills.</p> <ul style="list-style-type: none"> <li>- Know the basic components used in electronic functions</li> <li>- Master the fundamental electricity laws</li> <li>- Modelize (small- and large-signal) the components and how to use them</li> <li>- Search information in datasheets and know the vocabulary</li> <li>- Know the measurement methods and how to use the basic instrumentation devices</li> <li>- Master a simulation tool to estimate the performances of an electronic circuit</li> </ul>		
<b>Prerequisite:</b> None		

<b>DEP_1301</b>	<b>Electronic systems</b>	<b>Language</b> 
<b>Lecture: 28</b>	<b>Tutorials: 22, BYOD: 6</b>	<b>Lab work: 24</b>
<p>Contextualization, from an example, of the main functions in electronics.</p> <p>Circuits study frame: electricity</p> <ul style="list-style-type: none"> <li>- Voltage and current, ground, electrical signal, DC &amp; AC quantities, random quantities, power given to a dipole, decibels, dBm</li> <li>- Receptor and generator conventions, active and passive dipoles, linear (Thevenin-Norton equivalency) and non-linear dipoles, linearization around a static point</li> <li>- Putting linear circuits into matrix equations. Superposition, Thevenin, Millmann theorems</li> </ul> <p>Measurement &amp; component technology (lecture available online)</p> <p>Linear quadripoles, amplifiers</p> <ul style="list-style-type: none"> <li>- Linear quadripoles, descriptive matrix, input, output impedance, power gain</li> </ul> <p>Non-linear dipoles: diodes</p> <ul style="list-style-type: none"> <li>- Operation extern description, diode functions: rectifier, peak detection, alignment, clipping, non-linear transfer functions synthesis</li> <li>- Zener diode, application to voltage regulators</li> <li>- Internal operation, special diodes</li> </ul> <p>Integrated linear amplifiers</p> <ul style="list-style-type: none"> <li>- Operational amplifier circuits: linear operators, introduction to active filtering</li> <li>- Operational amplifier imperfections effect on the functioning of the circuit</li> <li>- Operational amplifier as comparators and applications</li> </ul> <p>Bipolar transistor, amplification circuits</p> <ul style="list-style-type: none"> <li>- Operation modes, polarization, linearisation and small-signal equivalent diagrams</li> <li>- Amplifier stages, cascade, switching, LED driver</li> </ul> <p>Field-Effect Transistors (FET)</p> <ul style="list-style-type: none"> <li>- JFET, MOSFET constitution, operation modes, polarization, small-signal model</li> <li>- Amplifier stages, use as variable resistor, gain control</li> <li>- Switches, CMOS</li> </ul> <p>Voltage regulator function</p> <ul style="list-style-type: none"> <li>- Regulators, extern characteristics, LDO (Low-dropout)</li> </ul> <p>Analog-Digital &amp; Digital-Analog conversion</p> <ul style="list-style-type: none"> <li>- Extern characteristics and realization of ADC and DAC</li> </ul>		

<b>PHYSICS_S5A</b> <b>Fall Semester</b> <b>Undergraduate/Junior</b>	<b>Physics 1A</b>	<b>4 credits</b> <b>Case study: 50%</b> <b>Final exam: 50% (3h)</b>
<p>This course aims at providing the basic notions in physics. At the outcome, the student will :</p> <ul style="list-style-type: none"> <li>- Acquire the general knowledge needed for the ENSEA curriculum and the understanding of emerging technologies (spintronics...)</li> <li>- Master the fundamental concepts of quantum physics (postulates) and electromagnetism</li> <li>- Modelize a simple physical problem to analyze it and infer its properties.</li> <li>- Acquire a general scientific methodology</li> </ul>		
<b>Prerequisite:</b> None		


<b>DEP_1312</b>	<b>Electromagnetism 1A</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 4</b>	
<p>Maxwell equations in vacuum and media</p> <ul style="list-style-type: none"> <li>- Electromagnetic wave propagation, free propagation in particular media, guided propagation, radiation, reflection, transmission and diffraction</li> </ul> <p>Light sources</p> <ul style="list-style-type: none"> <li>- Ideal light sources, imperfection and coherence of a real light source, dispersion, temporal coherence and interferences, coherency improvement, LASER sources.</li> </ul> <p>Wave optics</p> <ul style="list-style-type: none"> <li>- Diffraction and Fourier's optics, diffraction theory, applications.</li> </ul>		

<b>DEP_1312</b>	<b>Quantum electronics 1A</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 4</b>	
<p>Introduction to quantum physics: general principles and applications.</p> <ul style="list-style-type: none"> <li>- Highlight of the need of quantum physics with historical experiments (matters wave diffraction, Stern &amp; Gerlach, photoelectric effect...)</li> <li>- Recent technological advances: quantum computer, quantum cryptography, spintronics, tunnel-effect components</li> <li>- General principles: superposition, entanglement, uncertainty</li> </ul> <p>Fundamental tools</p> <ul style="list-style-type: none"> <li>- Wave &amp; matrix formulation: postulates, state vector/wave function, physical quantity measurement (results, possible state, statistics...)</li> <li>- Uncertainty principle, Schrodinger equation</li> <li>- Stationary states theory, tensor product, perturbations theory</li> </ul> <p>Spin, magnetism and applications</p> <ul style="list-style-type: none"> <li>- Magnetism fundamentals (magnetic moment, interaction energy)</li> <li>- Electron spin quantum description (Stern &amp; Gerlach, Pauli matrices...) and generalization (light polarization)</li> <li>- Applications (MRI, spintronics)</li> </ul> <p>Case study: Potential well and potential step, Quantum tunnelling, harmonic oscillator, atom...</p>		

<b>DEP_1313</b>	<b>Physics: case study</b>	<b>Language</b> 
	<b>Tutorials: 18</b>	
<p>Case study of a complex system in Physics, using notions learnt in this module. Students have to associate literature search, system analysis and modelisation, numerical simulation and experimentation potentially. The flipped classroom model is used and results are to be presented (possibly in English) in front of the class and summarized in a written report.</p>		




<b>LANGUAGES_S6A</b> <b>Spring Semester</b> <b>Undergraduate/Junior</b>	<b>Languages</b>	<b>4 credits</b> <b>Continuous exams</b> <b>English: 50%</b> <b>Second-language: 50%</b>
<p>This course aims at providing a communication tool both professional and general, develop autonomy in different skills (written and oral components). The goal is to obtain B2 as minimum level.</p> <p>Specific workshops take place all year: professional and technical English, presentations, resume writing, report writing, interview test, TOEIC, TOEFL preparations</p>		
<b>Prerequisite:</b> None		



<b>DSH_1111</b>	<b>English</b>	<b>Language</b> 
	<b>Tutorials: 26</b>	
<p>This course aims at providing a communication tool both professional and general, develop autonomy in different skills (written and oral components). The goal is to obtain B2 as minimum level.</p> <p>English classes will take place as elective workshops. Each student chooses a 7-week-workshop among four suggested by the teaching team. The 6 remaining weeks are used to develop the skill of oral defense on technical projects by also using written presentation.</p>		



<b>DSH_1112</b>	<b>German</b>	<b>Language</b>
	<b>Tutorials: 24</b>	
<p>The goal is to answer the needs and interests of future engineers. Lectures will not only focus on linguistic aspects, but also help to discover the culture and work in German countries. Communication competencies are focused on, students learn the language by using it. They are trained in speaking, listening, reading and writing in daily-life situations. Students are encouraged to prepare official language certificate internationally recognized, such as Goethe Institute certification.</p>		



<b>DSH_1113</b>	<b>Spanish</b>	<b>Language</b>
	<b>Tutorials: 24</b>	
<p>The main objective is to allow the students to acquire fundamental knowledge needed for a fluent daily life communication and to develop communication competencies required in professional environment. Lectures are also the place to introduce to Hispanic culture. Activities and documents are therefore focused on Hispanic sociocultural specificities. Teachings are divided in competencies levels (beginner, intermediate, advanced) in order to follow each student in their individual learning according to their prior knowledge. The major objective is to introduce or confirm the morphosyntactic and phonological notions. Communication competencies in the CECRL framework (speaking, writing and understanding) are organized in learning chapters aiming at developing pragmatic learning outcomes: presentation, description, discussion.</p>		

	<b>French for international students</b>	<b>Language</b> 
	<b>Tutorials: 24</b>	
<p>This course allows the students to learn the French language along with its culture.</p>		


<b>ELECTRONICS_S6</b> <b>Spring Semester</b> <b>Undergraduate/Junior</b>	<b>Electronics and components</b>	<b>6 credits</b> <b>Lab: 33%</b> <b>Final exam: 66% (3h)</b>
This course aims at providing the basic notions in understanding electronic systems and follows the Electronics S5 module. Outcomes and skills are therefore the same. It also allows the students to understand the physical phenomena that take place in semiconductors and modelize them.		
<b>Prerequisite:</b> Electronics S5		


<b>DEP_1321</b>	<b>Solid-state Physics</b>	<b>Language</b>  
<b>Lecture: 20</b>	<b>Tutorials: 12, TDm 8</b>	
The aim of the course is to enable students to understand a model of electrical components in terms of physical phenomena within the material itself.		
<ul style="list-style-type: none"> <li>- Crystal structures</li> <li>- Energy bands in solids: statistics in semiconductors, charge carriers dynamics in crystals</li> <li>- Population in thermodynamic equilibrium, Fermi surface</li> <li>- Effective mass</li> <li>- Intrinsic and Extrinsic semiconductors</li> <li>- Non-equilibrium semiconductors</li> <li>- Conduction &amp; Diffusion currents, generation &amp; recombination phenomena</li> <li>- Continuity equation</li> <li>- Classical devices: diodes, bipolar transistors, FET</li> <li>- Applications</li> </ul>		

<b>DEP_1322</b>	<b>Analog electronics II</b>	<b>Language</b>  
<b>Lecture: 10</b>	<b>Tutorials: 10</b>	
Transistor amplifiers: dynamics		
<ul style="list-style-type: none"> <li>- Optimal operating point: bipolar transistor and FET</li> <li>- Power Amplifiers classes, efficiency</li> <li>- Introduction to Microelectronics</li> <li>- Differential structures</li> <li>- Differential pair, current sources (discrete &amp; integrated), active loads, operational amplifier intern design</li> <li>- Active &amp; Passive filters synthesis</li> <li>- Frequency and impedance normalization, transposition</li> <li>- Butterworth, Tchebychev approximation</li> <li>- Active &amp; Passive filters synthesis</li> <li>- Sensitivity</li> </ul>		


<b>DEP_1323</b>	<b>Physics &amp; Electronics Lab</b>	<b>Language</b>  
		<b>Lab work :20</b>
Lab work sessions illustrate the two lectures of the module.		
<ul style="list-style-type: none"> <li>- Electronic components modelization</li> <li>- Power amplification, integrated structures</li> <li>- Active filters conception &amp; simulation</li> </ul>		



<b>AUTOMATION_S6</b> <b>Spring Semester</b> <b>Undergraduate/Junior</b>	<b>Control Engineering &amp; Energy II</b>	<b>4 credits</b> <b>Lab: 50%</b> <b>Final exam (3h): 50%</b>
This course aims at deepening the notions taught in linear systems and energy conversion. Control Engineering is mainly discussed using the state representation formalism. DC energy production is seen through AC-DC energy conversion, photovoltaic systems and batteries. DC machines are also studied.		
<b>Prerequisite:</b> Control Engineering & Energy I		

<b>DA_1411</b>	<b>Control Engineering</b>	<b>Language</b> 
<b>Lecture: 10</b>	<b>Tutorials: 8</b>	<b>Lab work: 12</b>
An advanced focus is done on the correction of linear systems using transfer functions. State-space representation is then introduced for a global study of systems using intern variables towards Kalman representation. <ul style="list-style-type: none"> <li>- PID controller, other controllers transfer functions</li> <li>- Continuous state-space representation: state variables and state-space representation</li> <li>- Stability, Kalman canonical realization, Companion realizations</li> <li>- Controllability, full state feedback, pole placement</li> <li>- Observability, observers</li> </ul>		



<b>DA_1412</b>	<b>DC energy production</b>	<b>Language</b> 
<b>Lecture: 10</b>	<b>Tutorials: 8</b>	<b>Lab work: 12</b>
In addition to the notions taught in the S5 semester, this course introduces bridge rectifier in order to study DC energy production from the electrical grid. DC energy is also linked to photovoltaic systems and storage in batteries. <ul style="list-style-type: none"> <li>- Main active components in power engineering</li> <li>- Uncontrolled and controlled rectifiers</li> <li>- DC machines modelization</li> <li>- Rectifiers &amp; DC machine, reversibility</li> <li>- Photovoltaic systems and battery storage</li> </ul>		



<b>COMPUTER_S6</b> <b>Spring Semester</b> <b>Undergraduate/Junior</b>	<b>Digital systems &amp; Microprocessors</b>	<b>5 credits</b> <b>Lab: 30%</b> <b>Computer exam (2h): 30%</b> <b>Final exam (2h): 40%</b>
<p>This course aims at deepening the notions taught in Computer Engineering in S5 semester by introducing sequential logic in digital circuits and basic elements of a microprocessor. Procedural programming and digital circuits allow the introduction to programming microprocessor-based systems.</p>		
<b>Prerequisite:</b> Digital systems & Computer		

<b>DITN_1522</b>	<b>Digital electronics II</b>	<b>Language</b> 
<b>Lecture: 6</b>	<b>Tutorials: 8</b>	<b>Lab work: 4</b>
<p>This course uses notions taught in the S5 semester and introduces sequencers. Finite state machines are introduced in theory and in implementation using reconfigurable circuits CPLD and FPGA. Memories are discussed from their structures and their use mechanisms.</p> <ul style="list-style-type: none"> <li>- Basic finite state machine conception (10 states, 4 inputs)</li> <li>- Finite state machines synthesis using VHDL</li> <li>- Finite state machine synthesis using flip-flop and combinatory elements</li> <li>- Memory mechanism and use</li> </ul>		


<b>DITN_1511</b>	<b>Microprocessors</b>	<b>Language</b>  
<b>Lecture: 6</b>	<b>Tutorials: 6</b>	<b>Lab work: 20</b>
<p>The first objective of this module is to learn about the microprocessor elementary functioning mechanisms and its architecture overview. Data coding and machine number representation are introduced.</p> <ul style="list-style-type: none"> <li>- Von Neumann architecture</li> <li>- Inside a microprocessor: ALU, memory, registers, pipeline</li> <li>- RISC model</li> <li>- Instruction coding, assembly language</li> <li>- Links to C programming language</li> <li>- Microcontrollers</li> <li>- Inputs/Outputs</li> </ul>		


<b>PROJECT_S6</b> <b>Spring Semester</b> <b>Undergraduate/Junior</b>	<b>Management &amp; project</b>	<b>6 credits</b> <b>Project: 50%</b> <b>Oral defense: 16,7%</b> <b>Final exam (2h): 33,3%</b>
<p>The aimed competences in Management &amp; project should enable the students to:</p> <ul style="list-style-type: none"> <li>- Implement different stages in the project development, from the expression of needs to realization and validation of a part or a global electronic system.</li> <li>- Manage the development (plan, define, share tasks among the members)</li> <li>- Communicate over the project</li> </ul> <p>These competences enable the student to:</p> <ul style="list-style-type: none"> <li>- Reformulate the expression of needs, understand the functional specifications, be able to complete those</li> <li>- Carry out the functional decomposition of a part or the global system</li> <li>- Carry out a Gantt diagram</li> <li>- Use the different knowledge learnt from the modules to search and study the solutions with sensible arguments</li> <li>- Use a simulation tool to estimate or verify the performances</li> <li>- Carry out a design case</li> <li>- Learn conception rules to realize printed circuit using a routing tool</li> <li>- Exploit technical documentation, carry out a validation case</li> <li>- Write a report and prepare an oral defense to report on the work achieved</li> </ul>		
<b>Prerequisite:</b> All previous courses		


<b>DEP_1601</b>	<b>Electronic project</b>	<b>Language</b>  
	<b>Tutorials: 4</b>	<b>Lab work: 44</b>
<p>The project to develop is a measurement or command system using sensors or actuators, a processing unit. A printed circuit is to be done using a routing tool.</p>		

<b>DSH_1601</b>	<b>Management fundamentals</b>	<b>Language</b>  
<b>Lecture: 18</b>	<b>Tutorials: 10</b>	<b>Lab work: 4</b>
<p>This module gives a global vision in operational and strategic management given an organization context and the environment influences (political, economical, social, environmental and legal). The objective is to increase the student awareness of current management stakes in organizations.</p> <p>The students should be able to:</p> <ul style="list-style-type: none"> <li>- Characterize an organization</li> <li>- Distinguish different company strategies, area and business</li> <li>- Appreciate the stakes of the company social responsibility</li> <li>- Give operational solutions from the present situation</li> <li>- Adopt a professional attitude</li> </ul> <p>All contents are linked to current practices in the organizations.</p> <ul style="list-style-type: none"> <li>- Managerial logic, entrepreneurship, intrapreneurship</li> <li>- Strategic approach: adaptation, position, strategic intention</li> <li>- Organization's aims, values and performance</li> <li>- Decision, power and governance</li> <li>- Manager functions and process: operational functions (production, marketing, purchases), support functions (finance and accounting, human resources, research &amp; development), transverse functions (information systems strategy)</li> <li>- People management (formal &amp; informal structure, leadership, change management, proximity management)</li> </ul>		

<b>SIGNAL_S6A</b> <b>Spring Semester</b> <b>Undergraduate/Junior</b>	<b>Mathematics &amp; Signal 1A II</b>	<b>6 credits</b> <b>Lab: 33,3%</b> <b>Final exam: 66,7% (2x2h)</b>
<p>Signal processing first consists in extract relevant data on levels, shapes and spectral content from the signal (signal characterization). Then, it formalizes the signals transformation from one physical shape to another; for instance, time-continuous electrical quantities to discrete-time quantified quantities which can be processed by digital systems. This course has the double objective to insist on sampling effect on signals and on the characterization of signals and filters in time and frequency domains. At the outcome, the student will be able to:</p> <ul style="list-style-type: none"> <li>- Know the influence of sampling frequency, width and shape of the observing window, DFT order, zero-passing...</li> <li>- Extract the spectral characteristics of a signal</li> <li>- Extract the relevant characteristics of a filter for a given application (order, delay, stability, linear phase, finite or infinite impulse response)</li> <li>- Envisage the use of a digital filter in a time-continuous signal processing chain</li> <li>- Define an optimal template and synthetize a filter responding to a given need, depending on the signal characteristics, the application and its environment</li> <li>- Implement this filter in a vector/matrix-programming language and verify its influence from time&amp; frequency representations of the output for a given input.</li> </ul>		
<b>Prerequisite:</b> Mathematics & Signal I 1A		

<b>DST_1211</b>	<b>Fourier analysis II 1A</b>	<b>Language</b> 
<b>Lecture: 14</b>	<b>Tutorials: 14</b>	<b>Tutorials (BYOD): 2</b>
<p>Analysis of time and frequency characteristics of a time-continuous signal and filter. Distribution space is introduced as a general study frame, covering continuous and discrete problems. One objective is to show its flexibility and the scope of the formalism. Continuous-time Fourier transform is considered in its generality.</p> <ul style="list-style-type: none"> <li>- Distributions</li> <li>- Fourier transform of a function</li> <li>- Fourier transform of a distribution</li> <li>- Dirac comb and Poisson's sum formula</li> <li>- Fourier transform of periodical functions</li> </ul>		

<b>DST_1212</b>	<b>Digital Signal Processing I</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 12</b>	<b>Tutorials (BYOD): 2</b>
<p>This lecture requires the continuous-time filtering basis introduced in the Fall Semester in order to bring answers to the following questions:</p> <ul style="list-style-type: none"> <li>- How to act on a signal?</li> <li>- How to analyze a signal spectrum?</li> <li>- What are the characteristics of a filter?</li> <li>- How to design a digital filter?</li> <li>- How to implement a digital filter to process time-continuous signals?</li> </ul>		

<b>DST_1213</b>	<b>Signal lab</b>	<b>Language</b> 
		<b>Lab work: 24</b>
<p>This Lab work has a double objective. First, it allows the students to implement the notions and tools seen in lectures to solve concrete problems linked to signal processing. Then, it allows the learning of the given software, which is not only useful but also really appreciated in companies.</p>		


## **ENSEA Second Year Syllabus**

*First year of Master or Graduate studies*

In the S7 semester, second-year students have to take six modules again. Two of them are compulsory : Languages and Management & Project modules. For the four others, they have to choose two minors and two majors among Automation, Electronics, Signal and Computer Science.


In the S8 semester, second-year students will follow the Languages and Management & Project modules, one minor and one major among Signal and Electronics. They also have to choose one elective course among 11 courses. An internship is compulsory.

<b>LANGUAGES_S7</b> <b>Fall Semester</b> <b>Graduate</b>	<b>LANGUAGES</b>	<b>4 credits</b> <b>Continuous exams</b> <b>English: 50%</b> <b>Second-language: 50%</b>
<b>Prerequisite:</b> None		

<b>DSH_2101</b>	<b>English</b>	<b>Language</b> 
	<b>Tutorials: 26</b>	
<p>The goal of this year is to prepare for the international experience, either academic or internship mobility. Focus will be given to resume and cover letter redaction, Business English, intercultural workshop, the way to speak in professional context or daily life, advanced notions on linguistic aspects. Workshops dedicated to different language certificates can be also suggested.</p>		


<b>DSH_2102</b>	<b>German</b>	<b>Language</b>
	<b>Tutorials: 24</b>	
<p>The goal is to answer the needs and interests of future engineers. Lectures will not only focus on linguistic aspects, but also help to discover the culture and work in German countries. Communication competencies are focused on, students learn the language by using it. They are trained in speaking, listening, reading and writing in daily-life situations. Students are encouraged to prepare official language certificate internationally recognized, such as Goethe Institute certification.</p>		

<b>DSH_2103</b>	<b>Spanish</b>	<b>Language</b>
	<b>Tutorials: 24</b>	
<p>In the following of the first-year learning, lectures will lead to an advanced acquisition of the language useful in a professional context. Skills groups (intermediate, advanced) will be made in order to allow a suitable following of the first-year teaching. Language fundamentals are reinforced and completed by more complex linguistic studies. The goal is to develop the communication skills either in a professional context or daily life. Students will have to learn the scientific &amp; technical language used by engineers. Cultural specificities will also be point out. At the end of this second-year learning, the students will speak fluent Spanish, corresponding to a B1 or B2 level in CECRL framework.</p>		


	<b>French for international students</b>	<b>Language</b> 
	<b>Tutorials: 24</b>	
<p>This course allows the students to learn the French language along with its culture.</p>		




<b>AUTOMATION_S7_MIN</b> Fall Semester Graduate	<b>Automation as a minor</b>	<b>4 credits</b> <b>Lab: 37.5%</b> <b>Final exam (3h): 62.5%</b>
<b>Prerequisite:</b> S5 & S6 Automation lectures		


<b>DA_2401</b>	<b>Energy Conversion I</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
<p>This course allows the study of the main static converters structures used in Power Engineering (chopper, switched-mode power supply) and presents the speed control in DC motors.</p> <ul style="list-style-type: none"> <li>- Power semi-conductor devices and magnetic devices</li> <li>- DC Power sources: batteries. Filtering.</li> <li>- Chopper: step down, two-/four-quadrant, inductive storage, Single Ended Primary Inductor Converter (SEPIC)</li> <li>- Speed variation of a DC motor powered by a four-quadrant chopper</li> </ul> <p>Lab work are dedicated to Flyback and Forward power supplies, reversible chopper, inverter.</p>		


<b>AUTOMATION_S7_MAJ</b> Fall Semester Graduate	<b>Automation as a major</b>	<b>6 credits</b> <b>Lab: 41.7%</b> <b>Final exam (3h): 58.3%</b>
<b>Prerequisite:</b> S5 & S6 Automation lectures		

<b>DA_2401</b>	<b>Energy Conversion I</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
Same as minor.		


<b>DA_2406</b>	<b>Energy Conversion II</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 12</b>	<b>Lab work: 16</b>
<p>This course follows the Energy Conversion I. It presents the main techniques of soft-switching (ZCS, ZVS) and their applications in resonance power supplies. It also introduces to power electronics devices dedicated to low-to-average power applications.</p> <ul style="list-style-type: none"> <li>- Power devices: diodes, transistors (MOSFET, IGBT), control, protections.</li> <li>- Soft-switching: principles, examples.</li> <li>- Introduction to resonance power supplies.</li> <li>- Converters simulation</li> </ul> <p>Lab work focuses on resonance power supply and contactless charging</p>		


<b>SIGNAL_S7_MIN</b> Fall Semester Graduate	<b>Signal as a minor</b>	<b>4 credits</b> <b>Lab: 37.5%</b> <b>Final exam (3h): 62.5%</b>
<b>Prerequisite:</b> S5 & S6 Signal lectures		


<b>DST_2201</b>	<b>Digital Signal Processing II</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
<p>The first module focused on characterizing discrete-time signals and digital filter in time and frequency domains. This advanced module allows:</p> <ul style="list-style-type: none"> <li>- The analysis of the frequency contents of a signal, the definition of SNR</li> <li>- The characterization of the filters (linear phase, phase shifter) effect on spectrum</li> <li>- The design of the filter / its transfer function to extract the wanted signal or attenuate the unwanted components</li> <li>- The implementation of the designed filter</li> <li>- The quantification of the enhancement brought by filtering in terms of SNR and periodogram</li> </ul> <p>Illustrations will be made on ECG signals, images... Lab work on Matlab focuses on design and implementation of filters, comparison between average and AR(1) filtering.</p>		

<b>DST_2202</b>	<b>Digital Communications</b>	<b>Language</b> 
<b>Lecture: 8</b>	<b>Tutorials: 8</b>	<b>Lab work: 8</b>
<p>This module presents the digital techniques of signal transmission. The objective is to allow the students to characterize a simple communications system and determine its main performances. Lab work uses a simulation software for communications systems.</p> <ul style="list-style-type: none"> <li>- Digital Baseband transmission: digital information representation, limited bandpass channel, intersymbol interferences, eye diagram, channel with Gaussian addition-noise, binary error rate.</li> <li>- Digital modulations: main modulations principles (ASK, FSK, PSK, QAM), trajectories, constellations, spectrum efficiency, demodulation techniques, modulation performances in presence of noise.</li> <li>- Introduction to channel-coding: linear-bloc codes, Hamming distance, syndrome, decoding and error correction.</li> </ul>		


<b>SIGNAL_S7_MAJ</b> <b>Fall Semester</b> <b>Graduate</b>	<b>Signal as a major</b>	<b>6 credits</b> <b>Lab: 41.7%</b> <b>Final exam (3h): 58.3%</b>
<b>Prerequisite:</b> S5 & S6 Signal lectures		

<b>DST_2201</b>	<b>Digital Signal Processing II</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
Same as minor.		


<b>DST_2202</b>	<b>Digital Communications</b>	<b>Language</b> 
<b>Lecture: 8</b>	<b>Tutorials: 8</b>	<b>Lab work: 8</b>
Same as minor.		


<b>DST_2206</b>	<b>Random signals</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 12</b>	<b>Lab work: 16</b>
<p>After a general introduction on random continuous and discrete-time processes, the second-order model in stationary case is only discussed using time-discrete signals. The characterization, filtering and model of signals originating from physical phenomena (speech, pressure measurement, communication signals) are viewed thanks to statistical tools.</p> <ul style="list-style-type: none"> <li>- Random process. Second-order properties, covariance function</li> <li>- Stationarity. Correlation function, application to delay estimation.</li> <li>- Power spectral density and z-density. Example: detection of a sine wave inside noise.</li> <li>- Mean estimator, autocorrelation estimator. Ergodism, estimators quality.</li> <li>- PSD estimation: correlogram, periodogram. Wiener-Khintchine theorem, average periodogram, windowing.</li> <li>- Linear filtering of processes. Interferences formula, multipath communication.</li> <li>- Processes model. AR, ARMA model, vocal tract model.</li> </ul>		

<b>ELECTRONICS_S7_MIN</b> Fall Semester Graduate	<b>Electronics as a minor</b>	<b>4 credits</b> <b>Lab: 37.5%</b> <b>Final exam (3h): 62.5%</b>
<b>Prerequisite:</b> S5 & S6 Electronics lectures		



<b>DEP_2301</b>	<b>Electronic Systems II</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
<p>This module focuses on analog electronics functions and fundamental concepts. At the end of the module, the students are able to design most of analog electronic circuits.</p> <ul style="list-style-type: none"> <li>- First harmonic approximation. Transistor model using this approximation. Non-linear behavior of amplifiers, distortion.</li> <li>- Oscillators</li> <li>- Phase-locked loop. Static, dynamic state, sequential detector loop</li> <li>- Transmission lines model. Behavior in transient state.</li> </ul>		



<b>ELECTRONICS_S7_MAJ</b> Fall Semester Graduate	<b>Electronics as a major</b>	<b>6 credits</b> <b>Lab: 41.7%</b> <b>Final exam (3h): 58.3%</b>
<b>Prerequisite:</b> S5 & S6 Electronics lectures		

<b>DEP_2301</b>	<b>Electronic Systems II</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
Same as minor.		


<b>DEP_2306</b>	<b>Electronic Systems II</b>	<b>Language</b> 
<b>Lecture: 12</b>	<b>Tutorials: 12</b>	<b>Lab work: 16</b>
<p>This module introduces the fundamental methods &amp; concepts for designing devices at high frequency: from 100 kHz (large-size or large-current circuits) to 10 GHz for usual devices in radiofrequency. Simulation tools designed for RF are used in tutorials and lab work.</p> <ul style="list-style-type: none"> <li>- Quartz, quartz oscillators.</li> <li>- Transmission lines in harmonic state, impedances, Smith chart.</li> <li>- Gain or impedance measurement in RF. S parameters.</li> <li>- Wires model in PCB, microstrip lines.</li> <li>- Elementary antennas.</li> </ul> <p>High-frequency model of passive or active devices. Impedance adaptation.</p>		


<b>COMPUTER_S7_MIN</b> Fall Semester Graduate	<b>Computer as a minor</b>	<b>4 credits</b> <b>Lab: 37.5%</b> <b>Final exam (3h): 62.5%</b>
<b>Prerequisite:</b> S5 & S6 Computer lectures		


<b>DITN_2501</b>	<b>Microprocessors</b>	<b>Language</b>  
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
<p>This advanced module allows the understanding of the different components of a system based on a microcontroller. The objective is reached using a guided-project using a STM32 controller and peripherals.</p> <ul style="list-style-type: none"> <li>- Interruption/exception transfer mechanism: interruption types, vectorization, interruption masking and management.</li> <li>- Microcontroller peripherals: microcontroller architecture, peripherals memory, clock, timer, ADC, DAC, extern peripherals.</li> <li>- Link with C language.</li> </ul>		


<b>DITN_2502</b>	<b>Object-oriented programming: JAVA</b>	<b>Language</b>  
<b>Lecture: 6</b>	<b>Tutorials: 14</b>	
<p>The module focuses on the object-oriented programming basis using JAVA language. The learning is done through practice guided by the development of an application. This module is complementary to the S5 C language module.</p> <ul style="list-style-type: none"> <li>- Classes, instances, references</li> <li>- Encapsulation, access</li> <li>- Inheritance, polymorphism</li> <li>- Error management, exceptions</li> <li>- Graphical interface, events management</li> <li>- Object-oriented design, design patterns</li> </ul>		


<b>COMPUTER_S7_MIN</b> Fall Semester Graduate	<b>Computer as a major</b>	<b>6 credits</b> <b>Lab: 41.7%</b> <b>Final exam (3h): 58.3%</b>
<b>Prerequisite:</b> S5 & S6 Computer lectures		

<b>DITN_2501</b>	<b>Microprocessors</b>	<b>Language</b> 
<b>Lecture: 16</b>	<b>Tutorials: 18</b>	<b>Lab work: 16</b>
Same as minor.		




<b>DITN_2502</b>	<b>Object-oriented programming: JAVA</b>	<b>Language</b> 
<b>Lecture: 6</b>	<b>Tutorials: 14</b>	
Same as minor.		



<b>DITN_2506</b>	<b>Network fundamentals</b>	<b>Language</b> 
<b>Lecture: 6</b>	<b>Tutorials: 6</b>	
<p>The course focuses on the design of communicating applications using a data transmission protocol. TCP/IP and internet network are the main targets.</p> <ul style="list-style-type: none"> <li>- General ideas of communication protocols</li> <li>- OSI model, norms</li> <li>- Local networks, access, routing</li> <li>- TCP/IP protocol</li> </ul>		

<b>DITN_2507</b>	<b>System programming</b>	<b>Language</b> 
<b>Lecture: 6</b>	<b>Tutorials: 6</b>	
<p>The course focuses on programming system applications offering services to other applications. Communication between application is explained, together with mutiprocesses programming.</p> <ul style="list-style-type: none"> <li>- Input and output at low level (open, clos, read, write, fctl)</li> <li>- Pipe, socket</li> <li>- Process creation (fork, exec)</li> </ul>		


<b>DITN_2508</b>	<b>Lab work</b>	<b>Language</b> 
		<b>Lab work: 16</b>
The lab work consists in developing a data server accessible through the network. FTP server, HTTP, IRC.		

<b>MANAGEMENT_PROJECT _S7 Fall Semester Graduate</b>	<b>Management &amp; Project</b>	<b>6 credits Exam(2h): 33.3% Oral defense: 66.7%</b>
<b>Prerequisite: S6 Management</b>		

<b>DEP_2701</b>	<b>Project</b>	<b>Language</b>   
		<b>Project: 48</b>
<p>The project takes place in S7 and S8. It embodies a truly important step for the Engineer student in his studies. It is indeed the first experience over a long period of designing and realizing a prototype which involves real industrial or research constraints.</p> <p>The objective is to let the student work as if he was in a R&amp;D department. Starting from an idea, he has to</p> <ul style="list-style-type: none"> <li>- Develop a global vision of the system</li> <li>- Write a design brief</li> <li>- Design the prototype</li> </ul> <p>The student will encounter issues such as reading past years work from other students, writing reports, choose and buy devices for the prototype. At the end of S7, the student has an oral defense to present his work until then.</p> <p>The project topics are spread on all the Engineering &amp; Research fields of ENSEA.</p>		


<b>DSH_2601</b>	<b>Innovation &amp; Project Management</b>	<b>Language</b>  
<b>Lecture: 10</b>	<b>Tutorials: 12</b>	
<p>At the end of the course, the Engineer student will deepen his knowledge in project management. The technical part of the project management seen in S6 is completed by a larger vision; the student has to think about the stages before the beginning of the project, the feasibility of the concept and its marketing (customer, competition). The objective is to develop and innovation.</p>		

<b>LANGUAGES_S8</b> <b>Spring Semester</b> <b>Graduate</b>	<b>LANGUAGES</b>	<b>4 credits</b> <b>Continuous exams</b> <b>English: 50%</b> <b>Second-language: 50%</b>
<b>Prerequisite:</b> None		

<b>DSH_2111</b>	<b>English</b>	<b>Language</b> 
	<b>Tutorials: 24</b>	
<p>The goal of this year is to prepare for the international experience, either academic or internship mobility. Focus will be given to resume and cover letter redaction, Business English, intercultural workshop, the way to speak in professional context or daily life, advanced notions on linguistic aspects. Evaluation consists in continuous exams. An evaluated 6-hour-workshop is done at the beginning of the semester.</p>		

<b>DSH_2112</b>	<b>German</b>	<b>Language</b>
	<b>Tutorials: 20</b>	
<p>The goal is to answer the needs and interests of future engineers. Lectures will not only focus on linguistic aspects, but also help to discover the culture and work in German countries. Communication competencies are focused on, students learn the language by using it. They are trained in speaking, listening, reading and writing in daily-life situations. Students are encouraged to prepare official language certificate internationally recognized, such as Goethe Institute certification.</p>		

<b>DSH_2113</b>	<b>Spanish</b>	<b>Language</b>
	<b>Tutorials: 20</b>	
<p>In the following of the first-year learning, lectures will lead to an advanced acquisition of the language useful in a professional context. Skills groups (intermediate, advanced) will be made in order to allow a suitable following of the first-year teaching. Language fundamentals are reinforced and completed by more complex linguistic studies. The goal is to develop the communication skills either in a professional context or daily life. Students will have to learn the scientific &amp; technical language used by engineers. Cultural specificities will also be point out. At the end of this second-year learning, the students will speak fluent Spanish, corresponding to a B1 or B2 level in CECRL framework.</p>		

	<b>French for international students</b>	<b>Language</b> 
	<b>Tutorials: 20</b>	
<p>This course allows the students to learn the French language along with its culture.</p>		





<b>ELECTRONICS_S8_MIN</b> <b>Spring Semester</b> <b>Graduate</b>	<b>Electronics as a minor S8</b>	<b>4 credits</b> <b>Lab: 37.5%</b> <b>Final exam (3h): 62.5%</b>
<b>Prerequisite:</b> S5-S7 Electronics lectures		


<b>DEP_2311</b>	<b>Analog modulations &amp; Noise</b>	<b>Language</b> ■ ■
<b>Lecture: 6</b>	<b>Tutorials: 6</b>	<b>Lab work: 8</b>
<p>This course allows the study of signal transmission, in its analog aspect.</p> <ul style="list-style-type: none"> <li>- Noise</li> <li>- Amplitude modulation</li> <li>- Frequency modulation</li> </ul>		

<b>DEP_2312</b>	<b>Electromagnetic Compatibility, Signal Integrity</b>	<b>Language</b> ■ ■
<b>Lecture: 8</b>	<b>Tutorials: 10</b>	<b>Lab work: 8</b>
<p>This course focuses on different electromagnetic interferences and their effects on electronic systems, especially the signal integrity issues and power (crosstalk, electromagnetic interferences, overshoot, multiple reflection, signal skew...). The idea is to make students aware of these issues as soon as the design of the circuit.</p> <ul style="list-style-type: none"> <li>- Definitions and rules specific to Electromagnetic Compatibility</li> <li>- Electromagnetic interferences. Classification by origin, time, spectrum, coupling type (conduction, , both), differential and common propagation mode, frequency and time characterization.</li> <li>- Coupling mechanism in harmonic state and transient state.</li> <li>- Screening effect</li> <li>- Devices and specific methods of EC protection</li> </ul>		

<b>ELECTRONICS_S8_MAJ</b> Spring Semester Graduate	<b>Electronics as a major S8</b>	<b>6 credits</b> <b>Lab: 41.7%</b> <b>Final exam (3h): 58.3%</b>
<b>Prerequisite:</b> S5-S7 Electronics lectures		

<b>DEP_2311</b>	<b>Analog modulations &amp; Noise</b>	<b>Language</b> 
<b>Lecture: 6</b>	<b>Tutorials: 6</b>	<b>Lab work: 8</b>
Same as minor.		

<b>DEP_2312</b>	<b>Electromagnetic Compatibility, Signal Integrity</b>	<b>Language</b> 
<b>Lecture: 8</b>	<b>Tutorials: 10</b>	<b>Lab work: 8</b>
Same as minor.		

<b>DEP_2316</b>	<b>Electronic System III</b>	<b>Language</b> 
<b>Lecture: 10</b>	<b>Tutorials: 10</b>	<b>Lab work: 16</b>
<p>This lecture shows some applications, from the analog point of view, systems and associated devices. Simulation tools will be used in tutorials and lab.</p> <ul style="list-style-type: none"> <li>- Link budget of radio or wired links. Electronic labels. RFID. Contactless charger.</li> <li>- Atomic clock, phase noise. GPS system.</li> </ul>		

<b>SIGNAL_S8_MIN</b> <b>Spring Semester</b> <b>Graduate</b>	<b>Signal as a minor S8</b>	<b>4 credits</b> <b>Lab: 37.5%</b> <b>Final exam (3h): 62.5%</b>
<b>Prerequisite: S5-S7 Signal lectures</b>		



<b>DST_2211</b>	<b>Statistics and numerical methods</b>	<b>Language</b> ■ ■
<b>Lecture: 14</b>	<b>Tutorials: 16</b>	<b>Lab work: 16</b>
<p>This course gathers applied mathematics methods. Two main chapters – estimation and significance tests – are seen from both the aspects of inferential and industrial statistics. The first point of view allows to solve random signals problems, only using time-method, and some telecommunications problems (decoding with maximum likelihood). Other topics, dealing with industrial statistics and Engineer general knowledge, are presented, such as Chi-Squared testing and quality control. Optimization problems coming from statistics are solved with a numerical method. Conversely, statistical methods allow the solution of optimization problems : a topic over stochastic optimization is discussed.</p> <ul style="list-style-type: none"> <li>- Random vectors, random processes, statistical samples management</li> <li>- Likelihood of a statistical model</li> <li>- Estimation one-point or over a range</li> <li>- Significance testing: parametric (Neyman-Pearson) and non-parametric (Chi-Squared)</li> <li>- Finite differences</li> <li>- Multiple-variable Differential Calculus</li> <li>- Optimization: gradient method, Newton method, least-squared method</li> <li>- Stochastic optimization</li> </ul>		



<b>SIGNAL_S8_MAJ</b> <b>Spring Semester</b> <b>Graduate</b>	<b>Signal as a major S8</b>	<b>6 credits</b> <b>Lab: 41.7%</b> <b>Final exam (3h): 58.3%</b>
<b>Prerequisite: S5-S7 Signal lectures</b>		



<b>DEP_2211</b>	<b>Statistics and numerical methods</b>	<b>Language</b> ■ ■
<b>Lecture: 14</b>	<b>Tutorials: 16</b>	<b>Lab work: 16</b>
Same as minor.		

<b>DEP_2216</b>	<b>Information theory and multimedia compression</b>	<b>Language</b> ■ ■
<b>Lecture: 10</b>	<b>Tutorials: 10</b>	<b>Lab work: 16</b>
<p>This course introduces the fundamentals in coding theory, source coding, error correction coding. Multimedia compression is then discussed (image, audio, video). JPEG images compression will be the golden thread since it includes lossless and lossy compression.</p> <ul style="list-style-type: none"> <li>- Information theory and digital communications: entropy, mutual information, source coding (Shannon theorem, Huffman algorithm, Markov sources), differential entropy of continuous random variables, Gaussian channel capacity.</li> <li>- Lossless compression, reversible: statistical algorithms, dictionary-based methods, arithmetic compression</li> <li>- Lossy compression, non-reversible: scalar and vector quantification, transformations and preparation to compression, restitution quality versus compression rate.</li> <li>- Channel coding: discrete channel without memory, capacity, Shannon theorem for coding theory, binary linear codes.</li> <li>- JPEG norms.</li> </ul>		


<b>MANAGEMENT_PROJECT_S8</b> <b>Spring Semester Graduate</b>	<b>Management &amp; Project</b>	<b>6 credits</b> <b>Oral in Management: 33.3%</b> <b>Technical defense: 66.7%</b>
<b>Prerequisite:</b> S7 Management & Project, S6 Management lectures		



<b>DEP_2711</b>	<b>Project S8</b>	<b>Language</b>  
		<b>Lab work: 40</b>
The project initiated at the previous semester keeps going on and will be evaluated both with a written report and a technical defense at the end of the lab work.		


<b>DSH_2611</b>	<b>Industrial Management</b>	<b>Language</b>  
<b>Lecture: 10</b>	<b>Tutorials: 12</b>	
<p>At the end of the course, the Engineer student will deepen its management knowledge learnt in S6 and acquire more professional and technical notions. This will enable the understanding the different functions in a company such as support functions but also central functions: risk management, quality, innovation, lean management, Agile and Scrum methods, outsourcing strategies.</p> <p>Tutorials will focus on oral communication. Two complementary parts will take place in the same time. In both parts, the exercises will rely on concrete elements for the students: the project, a participation to a contest... Thanks to the first part, the student will express himself with more ease in public. Work is focused on the voice, posture, body language and space management (particularly with a presentation on a screen). Thanks to the second part, the student will be able to use tools to pitch its project or idea and improve its presentation in front of different interlocutors or situations.</p>		

<b>DSH_2612</b>	<b>Recruitment meeting</b>	<b>Language</b>  
	<b>Tutorials: 4</b>	
<p>This course will help the students to feel more at ease with the upcoming recruitment meeting for jobs or internships. This activity is done with people specialized in recruiting recent graduated.</p> <ul style="list-style-type: none"> <li>- Presentation of the system, general rules, preparation (job offer analysis)</li> <li>- Individual meeting</li> <li>- Conclusion and assessment</li> </ul>		


<b>OPTION_S8</b> <b>Spring Semester</b> <b>Graduate</b>	<b>Option S8</b>	<b>6 credits</b> <b>Individual work: 50%</b> <b>Group work: 50%</b>
<b>Prerequisite:</b> none		



<b>DA_2801</b>	<b>Electrical Vehicles</b>	<b>Language</b> 
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course focuses on fundamental notions for a better understanding of the development of an electrical vehicle. Courses are divided in three modules and given by Engineers that are active actors in these developments.</p> <p>Economics module</p> <ul style="list-style-type: none"> <li>- Presentation of the current economic considerations for this type of vehicle</li> <li>- Stakes from the provider and customer point of view</li> <li>- Cost/autonomy compromise</li> <li>- Real examples of use, assessment</li> <li>- Comparison with the hybrid vehicles</li> </ul> <p>Energy module</p> <ul style="list-style-type: none"> <li>- Power supplies used in electrical traction</li> <li>- Physics of batteries, assessment of their performances</li> <li>- Fuel cells</li> <li>- Kinetic energy active recuperation</li> <li>- Batteries charging</li> </ul> <p>Traction module</p> <ul style="list-style-type: none"> <li>- Different types of motorization</li> <li>- Future motorizations</li> <li>- Transmission chain</li> <li>- Drive control chain</li> <li>- Modern driving assistance</li> </ul> <p>Industrial partners: Valeo, Renault, CEA</p>		



<b>DA_2802</b>	<b>Drones</b>	<b>Language</b>  
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course is an introduction to the design, realization, instrumentation and remote control of drones. These techniques could be generalized to other autonomous mechatronics systems.</p> <p><b><u>Contents</u></b></p> <ul style="list-style-type: none"> <li>• Notions of mechanics</li> <li>• Aerodynamics</li> <li>• Motorization</li> <li>• Sensor specifications (accelerometer, gyroscope, magnetometer, GPS...)</li> <li>• Sensor data fusion (Complementary or Kalman filter)</li> <li>• Control (PID, multivariable)</li> <li>• Microcontroller (STM32 family)</li> </ul> <p><b><u>Laboratory project</u></b></p> <ul style="list-style-type: none"> <li>• Testing a pre-built quadcopter drone</li> <li>• Acquisition (I2C/SPI protocols) and processing of sensors data (accelerometer, gyroscope, magnetometer...)</li> <li>• Generation of PWM control signals for motors</li> <li>• Dynamic modeling and simulation with Matlab/Simulink</li> <li>• Feedback and PID control</li> </ul> <p><b><u>Textbook</u></b>  <b>Fundamentals of Inertial Navigation, Satellite-based Positioning and their Integration</b>, A. Nouredin, T. Karamat, J. Georgy, <b>SPRINGER</b></p>		



<b>DEP_2803</b>	<b>Defense &amp; Security</b>	<b>Language</b> 
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course focuses on presenting the history and notions upon which the identification and recognition techniques are applied in military &amp; security domains. Some are also found in public domain. These techniques cover a broad range of scientific areas from analog electronics, radiofrequency, signal processing, digital electronics and physics. The module is divided into two main parts: one relative to military applications, the other one to identification applied to security.</p> <p>Electronics of Defense: Application of electronic techniques in Defense area has been done from many years. Radars are certainly one of the most complex and complete electronic system in military or civil equipment since they are used in civil airports, road prevention and automobile equipment. The following points will be discussed:</p> <ul style="list-style-type: none"> <li>- History of radars</li> <li>- Radar equation</li> <li>- Types and architectures</li> <li>- Electronic sweep antennas</li> <li>- Transmitters</li> <li>- Receivers</li> </ul> <p>Will also be discussed the electronic counter-measure:</p> <ul style="list-style-type: none"> <li>- Passive detection in electronic war</li> <li>- Auto-protection jamming</li> <li>- Offensive jamming</li> <li>- Electronic protection</li> <li>- Systems architecture</li> </ul> <p>Electronics of Identification and Security Identification techniques are old and have evolved since barcodes. In the past few years, new techniques have appeared and applied to security domain.</p> <ul style="list-style-type: none"> <li>- History</li> <li>- Spectrum and systems classification</li> <li>- RFID systems on near-field and far-field</li> <li>- Modulations and coding</li> </ul> <p>Security part is centered on biometry. Biometry is the identification technique that takes into consideration the morphological characteristics of the person: digital fingerprint, hand geometry, eye structure, voice tone, face geometry... Each technique is associated to more or less complex signal processing algorithms and adapted sensors.</p> <p>Industrial Partners: Thales, Safran Identity &amp; Security, Institute of Criminal Research of Pontoise</p>		





<b>DEP_2804</b>	<b>Multiphysics systems</b>	<b>Language</b> 
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>Design of industrial systems are linked to multidisciplinary issues. Dedicated tools exist but need interdisciplinary knowledge. The objectives are to guide students to understand what a model is, how to model physics problems, choose a numerical method to solve, criticize the solving tools, understand the results obtained and analyze them, handle an industrial project.</p> <ul style="list-style-type: none"> <li>- Finite elements and industrial cases</li> <li>- Micro Electro Mechanical Systems (MEMS)</li> <li>- Electrostatic transduction (accelerometer, energy harvesting,...)</li> <li>- Project (themes : MEMS, antenna, aerodynamics, acoustics, biological sensors...)</li> </ul> <p>Partners : ESYCOM, ESIEE Paris</p>		



<b>DEP_2805</b>	<b>Microelectronics</b>	<b>Language</b>  
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course introduces the technological processes involved to produce integrated circuits. In the context of MOS or mixed MOS &amp; bipolar transistor high performance, or FPGA targets, the design of analog and digital circuits is revisited. A rigorous method is presented to meet design goals (algorithms, performances, environment, and constraints) and achieve a physical realization.</p> <p><b><u>Contents</u></b></p> <ul style="list-style-type: none"> <li>• Presentation of technological processes for IC, introduction to nanotechnologies</li> <li>• <b>Workshop in a clean room</b>, prototyping and characterization of a basic IC</li> <li>• MOS Transistor, CMOS technology</li> <li>• Introduction to design methods (full custom, semi-custom, prediffused). Design-flow</li> <li>• Topology for integrated analog circuits: Op Amps, OTA. Design of state variables filters: gm-C and switched-capacitors approach. Translinear amplifiers, Gilbert multipliers.</li> <li>• Initiation to Computer Aided Design in industrial environment: Cadence and its tools</li> <li>• Full custom CAD of a simple analog function</li> <li>• Innovative architectures: systems on chip</li> </ul> <p><b><u>Laboratory project</u></b></p> <ul style="list-style-type: none"> <li>• SOC programming</li> </ul> <p>Partner : CEMIP (CNFM), ESIEE Paris</p>		



<b>DST_2806</b>	<b>Electronics and signal for musical applications</b>	<b>Language</b>  
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course focuses on providing</p> <ul style="list-style-type: none"> <li>- Competencies in digital audio area, musical acoustics and machine-learning applied to music</li> <li>- A mind-opening on philosophical and sociological questions linked to creative and innovative process.</li> </ul> <p>In the frame of this option, some ENSEA students may participate in collaborative projects in “Art and Science” together with students from ENSAPC and also follow some lectures in this institution completed by a compulsory module at ENSEA (Max/MSP, audio in embedded systems, electronics for audio applications and creative component). The collaborative project includes a first questioning about interaction between art and science or art and technology, then a production phase with a possible exhibition in an art center.</p> <p>Digital audio signal</p> <ul style="list-style-type: none"> <li>- Digital filtering in audio applications (ladder filter, notch, resonant filter)</li> <li>- Sliding Fourier transform, Q-transform</li> <li>- Sound synthesis (granular synthesis, physical model)</li> <li>- Audio for embedded systems: HTML5 Web Audio, audio in java</li> <li>- Tools for signal musical: Max/MSP, OpenMusic, jMusic/Java</li> <li>- Project-based instruction <ul style="list-style-type: none"> <li>o Piano sound synthesis algorithm in Max/MSP</li> <li>o Conception and implementation of a Q-transform</li> </ul> </li> </ul> <p>Machine-learning in musical applications</p> <ul style="list-style-type: none"> <li>- Musical Information Retrieval: musical segmentation, Hidden Markov Model</li> <li>- Shazam-type recognition algorithms</li> <li>- Fundamental frequency determination using delay method</li> <li>- Automatic recognition of grid chords using HMM</li> </ul> <p>Analog electronics for audio applications</p> <ul style="list-style-type: none"> <li>- Class A and class D power amplification</li> <li>- Filter for speakers</li> <li>- Microphones and transducers</li> <li>- Controlled-speaker, stability, full state feedback</li> <li>- Speaker characteristics measurement</li> <li>- Project-based instruction <ul style="list-style-type: none"> <li>o Conception of a low-noise pre-amplifier for ribbon microphone</li> <li>o Cancelling-noise algorithm for a room</li> </ul> </li> </ul> <p>Physics, acoustics and psycho-acoustics</p> <ul style="list-style-type: none"> <li>- Physics acoustics and propagation, impedances</li> <li>- Perception (the 3 ears, hearing cortex, pitch, intensity)</li> <li>- From JS Bach to Daft Punk: tone, musicality, consonance</li> <li>- Build Pythagorean tuning, characterization of a speaker</li> <li>- Model a concert room with a finite elements tool, build psychoacoustic masking curves</li> </ul> <p>Marketing, innovation, serendipity, creativity</p> <ul style="list-style-type: none"> <li>- Cultural factors in innovation, psycho-sociology of innovation, market segment</li> <li>- How technical innovation can modify the artistic creation process?</li> <li>- Smartphone applications as marketing added value in Music industry.</li> <li>- Audio, heritage and conservation, audio encoding standard durability</li> </ul> <p>Partners : TRACAM, Philips Leuven, Devialet, DJiT&amp;Lick</p>		

<b>DST_2807</b>	<b>Internet of Things</b>	<b>Language</b>  
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>IoT networks interconnect embedded physical objects such as distributed control systems used in autonomous vehicles and sensor networks used in structural health monitoring and smart cities. According to predictions, IoT will account for 45% of all Internet traffic by 2020, showcasing the importance of IoT applications.</p> <p>This elective course focuses on the architectures and protocols of IoT communication networks; we will study cases such as wireless sensor networks and vehicular IoT networks (V2V, V2X, X2V to assist driving). The option covers a wide range of topics, starting from the physical layer (PHY), and moving to IoT MAC and network layers (802.15.4, 6LoWPAN, ZigBee, etc.). Special topics, including IoT security protocols – IPsec, DTLS, etc., will also be covered. Students will have the chance to get introduced to the realm of IoT and experiment with intelligent, interconnected objects, they can potentially conceptualize, design and develop in the future as engineers.</p>		
<p><b><u>Contents</u></b></p> <ul style="list-style-type: none"> <li>• Communication networks for IoT</li> <li>• Fundamental trade-offs between rate, connectivity, latency</li> <li>• Wireless sensor networks</li> <li>• Energy consumption, energy harvesting</li> <li>• IoT PHY: NB-IoT</li> <li>• Networking for IoT, TCP-IP, IPv6, 6LoWPAN, ROLL/RPL</li> <li>• IoT Protocols, 802.15.4, ZigBee, RIOT, CoAP</li> <li>• IoT Security, DTLS, IPsec</li> <li>• Automotive IoT, V2V, V2X, X2V</li> </ul>		
<p><b><u>Laboratory topics:</u></b></p> <p>Laboratory sessions include MatLab® based experiments, experimentation with real IoT devices and remote access experimentation using the IoT FIT Lab at INRIA Saclay <a href="https://www.iot-lab.info/">https://www.iot-lab.info/</a>.</p>		
<p><b><u>Textbook</u></b></p> <ul style="list-style-type: none"> <li>• Moodle online resources</li> </ul>		
<p>Partners: Huawei, PSA</p>		

<b>DSH_2808</b>	<b>Security of Information Systems and data</b>	<b>Language</b> 
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course suggests a cross-cutting approach to study the Information and Communications Technology by using principles, methods and tools over the security of systems, data and communications.</p> <p>It particularly focuses on the upstream and downstream phases of the failures, crisis and potential infractions (property damage, intangible property damage, personal data infringement).</p> <ul style="list-style-type: none"> <li>- Upstream, at the conception level (security by design), security policies, security solution engineering, infrastructures architecture and technical equipment (embedded systems, communicating systems,, SCADA systems, smart networks...)</li> <li>- Downstream, on the audit a posteriori, feedback, criminalistics study of events (signal or image processing, metrology, electronic devices...)</li> </ul> <p>The cross-cutting approach also includes human sciences lectures (human factor management, organizational dimension, global costs evaluation, environment context understanding (constraints and actors), legal and judicial lectures (digital law, rules and interaction with the Labour law, criminal law, reconstitution of modus operandi)</p> <p>The objective is to develop competencies that can be used upstream at the conception level and secure solutions deployment, and downstream at the events analysis level and diagnosis prescriptions, solutions and preventive actions. The educational approach associates a global vision of trends and threats, action and organization principles which structure answers and case studies embodying the emerging state-of-art on security solutions.</p> <p>Partners: Digital criminality center of the national gendarmerie (C3N), Institute of research of the national gendarmerie (IRCGN), Institute of Technology Research SystemX, National Agency for information systems security (ANSSI), SFR, Airbus</p>		

<b>DSH_2809</b>	<b>Innovation and Entrepreneurship</b>	<b>Language</b> 
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course aims at bringing to students the competencies and knowledge needed to create and develop their own company. Lectures are given by experts who are stakeholders in company creation, so that the students have real notions and workshops that allow them to develop their project.</p> <p>Workshops include:</p> <ul style="list-style-type: none"> <li>- Highlight and identify an innovative idea, validate its realism</li> <li>- Do a market study</li> <li>- Build a business plan</li> <li>- Seek financial sources, crowdfunding, specific funds for innovators</li> <li>- How to pitch</li> <li>- Organize the protection of the specific competencies of the company: patents, copyrights...</li> <li>- Communication policy</li> <li>- Incertitude management</li> </ul> <p>Partners: Chamber of Commerce of Cergy, Neuvitec</p>		

<b>DITN_2810</b>	<b>Artificial Intelligence and Big Data</b>	<b>Language</b>  
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course is an introduction to artificial intelligence and its application to the processing of big quantities of data. Classification and prediction questions will be studied through different AI methods in order to find solutions for automatic image indexation or for recommendation systems.</p> <p><b><u>Contents</u></b></p> <ul style="list-style-type: none"> <li>• Data mining, introduction to data bases</li> <li>• Statistical learning, linear classifier, neuron networks, decision trees</li> <li>• Introduction to deep learning</li> <li>• Visual recognition, image interpretation</li> <li>• Recommendation systems, user profile generation</li> </ul> <p><b><u>Textbooks</u></b></p> <ul style="list-style-type: none"> <li>• Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016, <a href="http://www.deeplearningbook.org">http://www.deeplearningbook.org</a></li> <li>• Pattern Recognition and Machine Learning, Christopher Bishop, Information Science and Statistics, 2006</li> </ul> <p>Partners: Criteo, Qwant</p>		

<b>DITN_2811</b>	<b>Image and Virtual Reality</b>	<b>Language</b>  
<b>Lecture: 36</b>		<b>Lab work: 28</b>
<p>This elective course introduces digital signal processing for images, computer vision, virtual and augmented reality. After formal lecturing on these concepts, students will develop a project in teams of two students.</p> <p><b><u>Contents</u></b></p> <ul style="list-style-type: none"> <li>• Image generation, camera types</li> <li>• Image processing, linear filtering</li> <li>• Mathematical morphology, pattern recognition (Hough transform), segmentation</li> <li>• Computer vision: camera calibration, stereovision, structured light</li> <li>• Virtual reality: VR helmets technology, 3D modeller, 3D engine</li> <li>• Augmented reality: effects insertion, image synthesis</li> </ul> <p><b><u>Textbooks</u></b></p> <ul style="list-style-type: none"> <li>• Digital Image Processing, Gonzales &amp; Woods, 3<sup>rd</sup> edition, Pearson</li> <li>• Unity 5.x Game Development Blueprints, John P. Doran, 2016, PACKT</li> <li>• Game Engine Architecture, Jason Gregory, 2014, CRC press</li> </ul> <p>Partners: Illumination McGuff, Morpho, Onx, SNCF</p>		