



Ecole Nationale
Supérieure
de l'Électronique
et de ses Applications

ENSEA Course Description

DA	Department of Automation
DEP	Department of Electronics & Physics
DITN	Department of Computer of Science & Digital Systems
DSH	Department of Human Sciences
DST	Department of Signal & Telecommunications

The flag indicates the language of instruction

Two flags indicate that the course is offered in both French and English  

DEP 101A – Electromagnetism I

Level: Undergraduate/ Junior

Semester: Fall

Language of instruction: French

Lecture hours: 14 **Tutorial hours:** 12 **Lab hours:** none

Course Description:

The aim of this course is to further explore the phenomenon linked to the propagation of EM waves. We will particularly insist on the similarity of the propagation of EM waves and Hertz waves while making the students sensitive to the actual applications of each part of the course.

- Maxwell's equation, EM waves propagation, free propagation in particular media; guided propagation, radiation, reflection, transmission and diffraction
- Light sources, ideal light sources, imperfection and coherence of a real light source, dispersion, temporal coherence and interferences, coherency improvement, LASER sources.
- Diffraction and Fourier's optics, diffraction theory, classical aperture, use of Fourier transforms, applications.

Prerequisite:

None

DST 121A – Mathematics I

Level: Undergraduate/ Junior

Semester: Fall

Language of instruction: French

Lecture hours: 20 **Tutorial hours:** 20 **Lab hours:** none

Course Description:

This course allows the students to master the concepts and the tools of Calculus relative to the general representation of linear systems and to the signal spectral analysis. The distribution space is also introduced as a general frame of studies, dealing as well with the discrete or continuous problems. The exposition insists on the adaptability of use and on the impact of the introduced formalism. The study of the Laplace transform is minimal and oriented on the operating mode. More developments on the Fourier transform: energetic aspects, simple extension to the distribution, sampling theorem.

- Test and distribution functions. Distribution support, convolution product, convergence, Dirac's mass approximation
- Impulse trains. Decomposition of a Dirac impulse train in Fourier series
- Laplace transform, fundamental operating properties. Application: convolution and filtering
- Fourier transform of a function, Parseval's identity, uncertainty principle, auto-correlation and spectral density, calculation by the use of FFT
- Fourier transform of tempered distribution
- Periodical signal decomposition in Fourier series. L2 theory of Fourier series, auto-correlation and spectral density

Prerequisite:

None

DEP 105A – Analog Electronics I

Level: Undergraduate/Junior

Semester: Fall

Language of instruction: French , English 

Lecture hours: 24 **Tutorial hours:** 24 **Lab hours:** 24

Course Description:

This course allows the students to acquire the basic knowledge in the analysis of circuits realising the basic functions of electronics (rectifier, filtering, detection, comparison, and amplification). At the end of this course, the students must have an understanding of the notions of static and variable state in small signals as well as the notion of a model of an equivalent diagram.

- General laws and theorems of electronic circuits, active and passive dipoles, putting linear circuits into matrix equations
- Linear quadripoles, descriptive matrix, input, output impedance, power gain
- Non linear dipole, linearisation around a static point
- Semiconductor diodes, application to rectifier, to detection and to conformation
- Special diodes, varicap, Zener
- Operational amplifiers, linear and non-linear operators
- Operational amplifier imperfections effect on the functioning of the circuit
- Bipolar transistor, fundamentals of the internal functioning, characteristic diagrams, functioning modes
- Bipolar transistor polarisation, linearisation and equivalent diagrams for small signals
- Properties of the amplifier circuits with one transistor

Besides the illustration of certain parts of the course, the lab sessions will essentially deal with the handling of the basic instrumentation devices. Measurement of electric signals, frequency measurement, digital and analog measurement devices, oscilloscopes.

Prerequisite:

None

DA 125 – Energy Conversion I

Level: Undergraduate/Junior

Semester: Fall

Language of instruction: French 

Lecture hours: 16 **Tutorial hours:** 14 **Lab hours:** 12


Course Description:



- Electrokinetics
- Magnetic circuits, inductance, transformers
- Three-phase current


Lab sessions include three-phase transformers and three-phase circuits.

Prerequisite:

None

DA 127 – Linear Systems	
Level: Undergraduate/Junior	Semester: Fall
Language of instruction: French 	
Lecture hours: 18 Tutorial hours: 16 Lab hours: 12	
Course Description:	
<ul style="list-style-type: none"> - First order, second order linear systems, minimum-phase systems - Fourier transform, signal spectrum, distribution, linear filter - Laplace transform - Stability of linear systems - Nyquist and Routh-Hurwitz criteria 	
Prerequisite:	
None	

DITN 140 – C Language Programming	
Level: Undergraduate/ Sophomore/Junior	Semester: Fall
Language of instruction: French  , English 	
Lecture hours: none Tutorial hours: none Lab hours: 26	
Course Description:	
<p>This course allows the students to acquire sufficient knowledge in programming and algorithms to be able to understand the interdisciplinary aspect of computer science as a problem-solving tool.</p> <ul style="list-style-type: none"> - Data processing machines, structure of a PC, Linux and C language - Programming methods, debugging - Pointers, variables, operators - Functions - Input-output files 	
Prerequisite:	
None	

DITN 145A – Digital Electronics	
Level: Undergraduate/Junior	Semester: Fall
Language of instruction: French 	
Lecture hours: 22 Tutorial hours: 26 Lab hours: 20	
Course Description:	
<ul style="list-style-type: none"> - Two variable functions - Iterative methods, tree-patterns - Sequential logic design, finite state machines (Moore and Mealy) - Synchronous sequences, field programmable networks - Digital integrated circuits, TTL/CMOS/ECL - Numbers and operations 	
Prerequisite:	
None	

DSH 150 – Introduction to Fundamentals of Finance and Marketing

Level: Undergraduate/Sophomore

Semester: Fall

Language of instruction: French 

Lecture hours: 20 **Tutorial hours:** 10 **Lab hours:** 4

Course Description:

Hierarchy in companies, information and communication, accounting, costs, macroeconomics.

Prerequisite:

None

DSH – French Language and Culture

Level: Undergraduate/Senior / Graduate

Semester: Fall

Language of instruction: French , English 

Lecture hours: 45 **Tutorial hours:** none **Lab hours:** none

Course Description:

This course allows the students to learn the French language and also its culture.

Prerequisite:

None

DEP 105A – Quantum Physics

Level: Undergraduate/Senior

Semester: Spring

Language of instruction: French 

Lecture hours: 14 **Tutorial hours:** 12 **Lab hours:** none

Course Description:

This course in atom physics is an introduction to the second year course of semiconductor components physics, for which it is an essential basis. Less ambitious, by its content and its form than a real quantum physics course, it makes the engineering student sensitive to the fundamental concepts of atomic physics, though with an essentially phenomenological approach.

- Wave-particle duality. Planck's constant, black-body radiation, photoelectric effect, Compton effect, De Broglie wavelength, diffraction on electron waves, interferences.
- The atom model, energy quantification, Franck and Hertz experiment, limitations of the Bohr model, quantum numbers.
- Uncertainty laws, particle wave function, wave packets, phase and group velocity, Fourier transform.
- Introduction to quantum mechanics, properties of the wave function, observable operator, quantum mechanics postulates, Schrödinger equations, Ehrenfest theorems
- Angular momentum in quantum mechanics
- Hydrogenous atoms, Hamiltonian of a the two-body problem, atom in a magnetic field
- Electron spin, Stern-Gerlach experiment, application to magnetic resonance.

Prerequisite:

None

DEP 111 – Analog Electronics II

Level: Undergraduate/Junior

Semester: Spring

Language of instruction: French  , English 

Lecture hours: 22 **Tutorial hours:** 22 **Lab hours:** 24

Course Description:

This course builds on the previous course in the perspective of the synthesis of analog functional sets.

- Dynamic of the transistor amplifier
- Association of transistors, cascaded amplifiers, direct connection, connection by a capacitor
- Bandwidth limitation in LF and HF

Prerequisite:

Analog Electronics I

DEP 119A – Analog Electronics Project

Level: Undergraduate/Junior/Senior

Semester: Spring

Language of instruction: French , English 

Lecture hours: none **Tutorial hours:** none **Lab hours:** 20

Course Description:

This is the practical synthesis of a simple function: transimpedance amplification, light integrator, proximity infrared detector, class D audio amplifier...

This course can also be as a short course, capstone project or independent study to meet international visiting students' study abroad requirements

Prerequisite:

Analog Electronics I & II

DST 122A – Mathematics II

Level: Undergraduate/Junior

Semester: Spring

Language of instruction: French 

Lecture hours: 12 **Tutorial hours:** 12 **Lab hours:** 12

Course Description:

This course aims to present complex variables, functions and Hilbertian functions - function analysis, orthogonal functions.

- Laurent series, complex logarithm and exponential functions
- Cauchy integrals, Cauchy-Riemann conditions
- Integral calculus
- Linear sample filters, z transforms - ARMA filters
- Hilbert-Schmidt integral operators, Fourier series, orthogonal polynomials, Legendre Polynomials, Chebyshev polynomials, Haar-Hermite-Bessel polynomials.

Prerequisite:

Mathematics I

DA 126 – Energy Conversion II

Level: Undergraduate/ Senior

Semester: Spring

Language of instruction: French 

Lecture hours: 16 **Tutorial hours:** 14 **Lab hours:** 12

Course Description:

- DC machines
- Introduction to power electronics

Lab sessions include DC machines and speed variation of a DC machine.

Prerequisite:

Energy Conversion I

DA 128 – Control Systems

Level: Undergraduate/Junior/Senior

Semester: Spring

Language of instruction: French

Lecture hours: 12 **Tutorial hours:** 12 **Lab hours:** 12

Course Description:

- Adaptive control
- Non linear control systems
- Stability studies
- Closed-loop corrections
- Open-loop study
- Correctors
- Process identification

Prerequisite:

None

DST 130 – Discrete Systems

Level: Undergraduate/ Junior

Semester: Spring

Language of instruction: French

Lecture hours: 14 **Tutorial hours:** 12 **Lab hours:** 12



Course Description:



This course introduces Discrete Time Systems. Students should be able to model sampling operations as well as the reconstruction of analog signals to determine the spectra of sequences and to calculate the transfer of usual discrete systems by ensuring their stability.



- Samplings - Shannon's theorem
- Discrete Signals - Fast Fourier Transform, Discrete Fourier Transform and Z transform
- Discrete Linear Systems - non variable systems and stability
- Applications (digital filters - analog reconstruction of a signal and DFT)

Prerequisite:

None

DITN 141 – Data structures	
Level: Undergraduate/Junior/Senior	Semester: Spring
Language of instruction: French  , English 	
Lecture hours: 4 Tutorial hours: none Lab hours: 12	
<p>Course Description:</p> <ul style="list-style-type: none"> - Linked lists - Graphs - Trees - Application to databases <p>This course can be followed and completed by a Capstone Project /Special problem/Independent Study, individually tutored over another 20 hours lab work.</p> <p>Prerequisite: C Language Programming</p>	

DITN 145A – Digital Electronics Project	
Level: Undergraduate/Junior/Senior	Semester: Spring
Language of instruction: French  , English 	
Lecture hours: none Tutorial hours: none Lab hours: 24	
<p>Course Description:</p> <p>Design and realization of a model, simple digital system organized around a sequence, and use of programmable elements. Equivalent to a Capstone project/Independent study.</p> <p>This course can also be taken in English as a short course, capstone project or independent study to meet international visiting students' study abroad requirements.</p> <p>Prerequisite: Digital electronics</p>	

DITN 147 – Microprocessors I	
Level: Undergraduate/Junior	Semester: Spring
Language of instruction: French  , English 	
Lecture hours: 14 Tutorial hours: 4 Lab hours: 24	
<p>Course Description:</p> <ul style="list-style-type: none"> - Functional architecture of a processor - Coding, fetch/ execute cycle - Addressing, pointers - Fixed/floating point numbers, representations - Natural binary code, binary-coded decimal (BCD) - Result indicators - STM32 microprocessors, architecture, memory assembly language - Program structuring - Modular programming, links <p>Prerequisite: C Language Programming</p>	

DSH – French Language and Culture

Level:

Undergraduate/Junior/Senior/Graduate

Semester: Spring

Language of instruction: French , English 

Lecture hours: 45 **Tutorial hours:** none **Lab hours:** none

Course Description:

This course allows the students to learn the French language and its culture.

Prerequisite:

None

DEP 205 – Solid State Physics

Level: Graduate

Semester: Fall

Language of instruction: French

Lecture hours:28 **Tutorial hours:**24 **Lab hours:**none

Course Description:

The aim of the course is to enable students to interpret a model of electrical components in terms of physical phenomena within the material itself.

- Crystal structure and binding
- Theory of energy bands in solids
- Dynamics of electrons in crystal/ band theory of electrons and holes
- Electrons density at thermodynamic equilibrium
- Fermi surface
- Semi-conductors
- Conduction currents; diffusion, drift and recombination.
- Equations of continuity.
- Light-emitting diodes, bipolar junction transistors, FET's, Gunn Diodes, schematic models, small signals, commutations, elements of technology

Prerequisite:

Analog Electronics I and II, Quantum Physics

DEP 210 – Analog Electronics III

Level: Graduate

Semester: Fall

Language of instruction: French

Lecture hours:26 **Tutorial hours:**24 **Lab hours:**24

Course Description:

The aim of the course is to study some of the essential functions of analog electronics. The methods of analysis and the synthesis of circuits corresponding to these functions will be introduced. The competence acquired in the course will enable students to go beyond the study of circuits

- Phase Locked Loop.
- Frequency synthesis - direct synthesis, fractional synthesis
- Filters - size, group propagation time, normalization and transposition
- Function of standard filters, Butterworth, Chebyshev, Bessel, Cauer
- Design of passive filters, resonance, coupling of filters
- Design of active filters, switched capacitors filters.
- Nonlinear systems
- Oscillators, quartz oscillators, high level amplifiers
- Propagation - coefficient of reflexion, impedance

Prerequisite:

Analog Electronics I and II

DEP 210 – Numerical Analysis

Level: Graduate

Semester: Fall

Language of instruction: French 

Lecture hours:10 **Tutorial hours:**12**Lab hours:**22

Course Description:

This course centres on the numerical methods, matrices and introduces the basic ideas of numerical algorithms, exact or approximate; the complexity of calculation, conditionality and numeric stability of a problem, error theory and convergence, propagation of errors of rounding off.

- Vectors, norms and matrices, matrix subordinates
- Linear system, Gauss method, conditioning of a system, complexity and evaluation of numeric precision in machines
- Applications of linear systems, interpolation, conditioning, differential methods with finite differences, method of Newton's multidimensionality
- Factorization of matrices, Householders, Schur form
- Eigenvalues of matrices, conditioning, method of iteration, QR algorithm, study of convergence, convergence acceleration
- Applications of calculations of eigenvalues: polynomial roots, stability of systems, modes of vibration, data analysis.

Lab sessions deal with linear systems, conditioning and numeric precisions, optimization (gradient and Newton), QR algorithms and applications

Prerequisite:

None

DITN247 – Microprocessors II

Level: Graduate

Semester: Fall

Language of instruction: French 

Lecture hours:10 **Tutorial hours:**4**Lab hours:**16

Course Description:

- Interruptions
- Priority
- State, Data & Command registers
- Peripherals configuration
- C & assembly languages

Prerequisite:

C Language Programming, Microprocessors I

DA225 – Energy Conversion III

Level: Graduate

Semester: Fall

Language of instruction: French 

Lecture hours:18 **Tutorial hours:**16 **Lab hours:**12

Course Description:

- Characteristics of convertors, asynchronous and synchronous machines, transmission losses
- Semi-conductors, power devices, magnetic devices.
- Amplifiers.
- Bipolar transistors – Flyback and Forward alimentations

Prerequisite:

Energy Conversion I and II

DST231 – Probability and Statistics I

Level: Graduate

Semester: Fall

Language of instruction: French 

Lecture hours:14 **Tutorial hours:**12 **Lab hours:**none

Course Description:

This course aims to introduce the fundamental concepts of probability and statistics. These concepts will be useful in various fields: signal processing, measurements, reliability, quality, economics and management. This course combines a statistical approach (samples, empiric measurements) and the probability theory (random variables and vectors, converging theorems).

- Descriptive statistics and probability models
- Empiric frequency, probability, independence, conditioning; Bayesian procedures
- Real and random variables, distributive functions, density, moments, characteristic functions, analysis of central limit theorems, variance and covariance

Prerequisite:

None

DST235 – JAVA Language Programming

Level: Graduate

Semester: Fall

Language of instruction: French 

Lecture hours:6 **Tutorial hours:**none **Lab hours:**12

Course Description:

This course presents the object-oriented language concepts and applied it to JAVA language.

Prerequisite:

None

DEP269 - Project Thesis

Level: Graduate

Semester: Fall

Language of instruction: French , English 

Lecture hours: none **Tutorial hours:** none **Lab hours:** 56

Course Description:

A one-semester project whose goal is to design a device or software from the beginning to the end. The subject is to be defined with the student.

Prerequisite:

Depends on the project.

DEP 207 – Electromagnetic Compatibility

Level: Graduate

Semester: Spring

Language of instruction: French 

Lecture hours:14 **Tutorial hours:**10**Lab hours:**12

Course Description:

This course presents the fundamentals of electromagnetic compatibility. The object is to sensitize the students to effects, diverse electromagnetic disturbances and their influence on electrical systems. It shows equally the interest in taking into account the aspects of electromagnetic compatibility in the design of such systems.

- Specific definition of electromagnetic compatibility. Immunity, susceptibility, margins of compatibility, principal units, norms
- Electromagnetic disturbances, characteristics and modelization, effects on electrical components
- Coupling mechanisms, coupling by magnetic inductance, coupling by electrical induction, coupling by common impedance, remedies
- Electromagnetic field
- Cables' connections, triaxial and quadriaxial cables
- Mass and the earth
- Tracing of printed circuits
- Components and protection circuits
- Measurement and instrumentation for electromagnetic compatibility. Methods of measurement, generators of disturbances, spectrum analysis, anechoic chamber.

Prerequisite:

Analog Electronics I and II, Electromagnetism

DEP 207 – Physics Lab

Level: Undergraduate/Senior/Graduate

Semester: Spring

Language of instruction: French , English 

Lecture hours:none **Tutorial hours:**none**Lab hours:**12

Course Description:

- Use of Femlab to simulate a pn diode
- Theme study between optical fibers, NMR, X-rays, MOS study, optical filtering...
- Can be taken as a Capstone Project, Special Problem or Independent Study

Prerequisite:

Electromagnetism, Solid State Physics

DST232 – Probability and Statistics II

Level: Graduate

Semester: Spring

Language of instruction: French 

Lecture hours:14 **Tutorial hours:**14**Lab hours:**12

Course Description:

- Random vectors, density, distributive functions, characteristic functions, covariance analysis, random Gaussian vectors, linear and quadratic estimative functions
- Sampling techniques and population, plausibility functions
- Confidence intervals, properties of estimators, comparisons and design of estimators, hypotheses testing
- Simple and multiple regression, ANOVA, ANCOVA and maximum likelihood

Lab sessions deal with probability simulations, estimations and statistical tests, linear, simple and multiple regression

Prerequisite:

Probability and Statistics I

DST233 – Random Signal Analysis

Level: Graduate

Semester: Spring

Language of instruction: French 

Lecture hours:14 **Tutorial hours:**12**Lab hours:**12

Course Description:





Having introduced random processing (continuous and discrete time), stationarity, 2nd order modeling is seen only for discrete signals. Characterisation, filtering and modeling for signals from physical phenomena (voice pressure measurements, communication signals) are approached by using statistical tools.

- Random Processing, 2nd order characteristics, covariance functions
- Application for delay estimation
- Power spectral density and z density: example: sine detection in noise signals
- Estimation of random variables
- DSP estimation, correlogram and periodogram - Wiener-Kinchine theorem
- Linear filtering, ARMA models

Lab sessions deal with Fourier spectral analysis & AR model identification.

Prerequisite:

Probability and Statistics I and II

DST235 – Signal Transmission	
Level: master	Semester: Spring
Language of instruction: French 	
Lecture hours: 24 Tutorial hours: 22 Lab hours: 24	
Course Description: <p>This course presents the analog and digital techniques for signal transmission. The introduction of the theory of information leads to the notion of channel capacity and establishes the basic encoding rules. This course aims to enable the student to master the concepts of communication systems and to measure their performances.</p> <ul style="list-style-type: none"> - Information theory- discrete source entropy, source encoding, channel encoding, detection and error correction, linear block codes - Analog transmission, amplitude modulation - Performance measures - digital modulations - Digital transmissions, digital information, representation, baseband transmission, multiplexing - Modems, antennas <p>Lab sessions deal with digital modulation and demodulation techniques (amplitude, frequency and noise)</p>	
Prerequisite: Analog Electronics I, II and III	
DSH250 – Supply Chain Management	
Level: Undergraduate/Senior/Graduate	Semester: Spring
Language of instruction: French 	
Lecture hours: 28 Tutorial hours: 16 Lab hours: none	
Course Description: Study of the supply chain management.	
Prerequisite: C Language Programming, Microprocessors I	
DEP269 – Project Thesis	
Level: Undergraduate/Senior/Graduate	Semester: Spring
Language of instruction: French  , English 	
Lecture hours: none Tutorial hours: none Lab hours: 56	
Course Description: A one-semester project whose goal is to design a device or software from the beginning to the end. The subject is to be defined with the student. Equivalent to a Capstone Project, Special Problem, Independent Study.	
Prerequisite: Depends on the project.	