ENSEA
Ecole Nationale
Supérieure
de l'Electronique
et de ses Applications

FAME
French
American
Exchange
Program

ENGINEERING COURSES TAUGHT IN ENGLISH

SPRING SEMESTER

	ENSEA	FAME
	Electronic Circuits & Laboratory	
US Credits : 3+3	Lecture : 45h ; Laboratory : 44h	Language : English

Summary

Analysis of integrated amplifiers with bipolar junction transistors and field-effect transistors. Transistors linear equivalent models at high frequencies. Frequency response of transistor amplifiers. Feedback configurations, stability and compensation. Analog integrated circuits: differential-pair, current source, active load, operational amplifier.

To reinforce concepts, laboratory experiments involve work with real components on didactic circuits and PSpice simulations.

Prerequisites

- DC and AC circuit analysis.
- Bipolar and field-effect transistor operating principles, basic biasing techniques.
- Small signal analysis of single-stage transistor amplifiers.

Contents

Course objectives: After completing this course, the student should be able to do the following:

- Determine the frequency response (low, mid, high) of a single and multi-stage transistor amplifier mathematically (transfer function) and graphically (Bode plots).
- Design an amplifier circuit with required frequency response.
- Determine the gain, input and output resistances, bandwidth of a feedback amplifier circuit.
- Identify and analyse the different stages of an operational amplifier.

Topics:

- Low frequency response of single-stage transistor amplifier.
- Design of the coupling and bypass capacitors.
- BJT and FET equivalent models at high frequencies.
- High frequency response of single stage transistor amplifier.
- Cascode configuration, comparison of common-emitter and cascode frequency response.
- Feedback topologies. Properties of negative feedback.
- Stability study using Bode magnitude and phase plots. Frequency compensation.
- Basic microelectronic circuits: differential pairs, current sources, active loads.
- Analysis of the different stages of an operational amplifier.
- Operational amplifier characteristics and operating principles.

Laboratory topics:

- Characteristics and biasing of a BJT, BJT single-stage amplifiers. BJT two-stage amplifier
- FET amplifier, automatic gain control
- Multiple-stage amplifier design. Constant current source. Bipolar differential amplifier
- Amplifiers with negative feedback .Operational amplifier characteristics. Applications of operational amplifiers

Organization

- One 3-hour session of lecture per week during 15 weeks. The group of students is small enough to intertwine formal lecturing and exercises. The marking will be based on written tests and homework.
- One 4-hour session of laboratory experiments per week during 11 weeks. The marking will be based on preparations, work during the sessions and lab reports.

Textbook

1. A. Sedra and K. Smith, Microelectronic Circuits, Oxford University Press, 6th Edition

Similar to the following courses

- IIT Chicago ECE 312
- University at Buffalo EE 311&353
- Georgia Tech ECE 3040&3042
- Univ. of Pittsburgh ECE 1286&1212
- Colorado School of Mines EGGN 385
- University of Colorado at Boulder ECEN 3250
- University of Illinois at U-C ECE 342&343
- Mississippi State University ECE 3434
- University of Michigan at AA EECS 311 (4 cr)

	ENSEA	FAME
	Computer Architecture and Introduction to Microprocessors	
US Credits : 3	Lecture : 17h ; Laboratory : 28h	Language : English

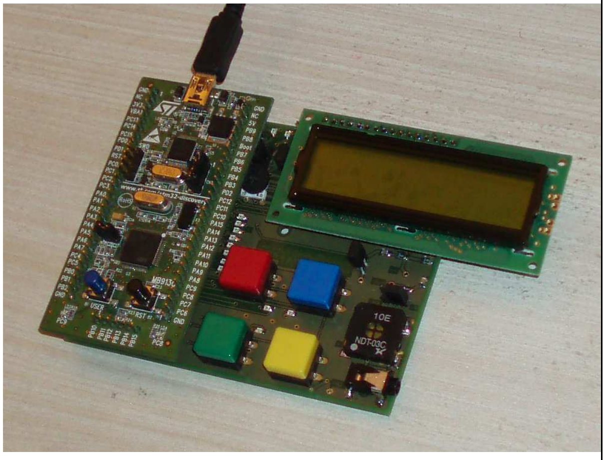
Summary

The goals of this course are to understand the main principles of a microprocessor system. It's both based on basic courses about microprocessor and laboratory works on a real embedded system.

Prerequisites

- Digital Electronics.
- C or C++ language.

Contents



This is a lab-oriented course in which classroom topics are explored through in-depth experiments in laboratory projects. First, the students understand what a microprocessor is thanks to the LMC model (Little Man Computer). Then, step by step, basic concepts are described: data representation, arithmetic and logic unit, RISC principles, pipelining, memory types, assembly language. Then students have to program a Cortex M3 microcontroller (ARM) based board in assembly language and C. Thanks to this work they understand how a microprocessor works, what is a procedure and the relation to high-level language are explored. They also discover what linking and downloading mean. Then students program a simple interface with switches, LEDs and even a LCD display. This is a way to introduce: I/O, peripheral devices. Courses and laboratory works are mixed. At the beginning, there are mostly courses then at the end mostly laboratory sessions.

Topics:

- Basic microprocessor principles: fetch, decode and execute cycle + pipeline, memory.
- Numbers systems, signed and unsigned integers, addition, subtraction and flags, floating point numbers.
- Machine code, assembly language, assembler.
- Instruction set: taking decision, moving data…
- From C to assembly language: compiler.
- Exception handling and interrupts.
- Microcontroller and embedded systems.

Organization

One 3-hour session per week for 15 weeks. The group of students is small enough to intertwine formal lecturing, exercises and laboratory. The grading is based on written tests and homework.

Textbook

Similar to the following courses

- IIT Chicago CS 470
- University at Buffalo CSE 379&380
- Georgia Tech
- University of Pittsburgh CS 0447
- Colorado School of Mines CSCI 341
- University of Colorado at Boulder CSCI 4593
- University of Illinois at U-C CS 231 & 232
- Mississippi State University ECE 3724/ECE 4713
- University of Michigan at AA

NEW COURSE	ENSEA	FAME
	Algorithms design and analysis	
US Credits : 3	Lecture ; Tutorials; Laboratory work	Language : English

Summary

This course covers basic techniques of design and analysis of efficient algorithms for standard computational problems.

Prerequisites

Contents

A broad range of the most commonly used algorithms will be detailed. Some examples include algorithms for sorting, searching, encryption, compression and local search. The students will implement and test several algorithms:

- Recursion
- Dynamic programming
- Greedy algorithms
- Divide-and-conquer
- Dynamic Data Structures
- Fundamental graph algorithms

Organization

One 3-hour session per week for 15 weeks. The group of students is small enough to intertwine formal lecturing, exercises and laboratory.

Textbook

T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduction to Algorithms, The MIT Press, 3rd edition (July 31, 2009)

Similar to the following courses

- IIT Chicago CS 430
- University at Buffalo CSE 331
- Georgia Tech CS 3510
- University of Pittsburgh CS 1501
- Colorado School of Mines CSCI 406
- University of Colorado at Boulder CSCI 3104
- University of Illinois at Urbana-Champaign CS 473
- Mississippi State University CSE 2383 / CSE 4833

NEW COURSE	ENSEA	FAME
	Operating Systems	
US Credits : 3	Lecture ; Tutorials; Laboratory work	Language : English

Summary

The purpose of this course is to understand and use the basic concepts of operating systems.

Prerequisites

Good understanding of C programming language.

Contents

The basic concepts of operating systems are common to most computer systems, and enable the interfaces between the computer and the programmer. The linux kernel will be taken as example to analyze common mechanisms. Concepts listed below will be discussed:

- process management, process data structures, scheduling
- memory management, virtual memory
- inter-process communication, signal, shared memory, semaphores, message queues
- Threads, condition variables
- kernel initialization, kernel modules programming

Organization

One 3-hour session per week for 15 weeks. The group of students is small enough to intertwine formal lecturing, exercises and laboratory.

Textbook

1. D. P. Bovet, M. Cesati, Understanding the Linux Kernel, O'Reilly Media (October 2000)
2. A.S. Tanenbaum, Modern Operating Systems, Prentice Hall, 3 edition (December 21, 2007)

Similar to the following courses

- IIT Chicago CS 450
- University at Buffalo CSE 421
- Georgia Tech CS 3210
- University of Pittsburgh CS 1550
- Colorado School of Mines CSCI 442
- University of Colorado at Boulder CSCI 3753
- University of Illinois at Urbana-Champaign CS 423
- Mississippi State University CSE 4733

	ENSEA	FAME
	Signals and Systems	
US Credits : 3	Lecture : 30h ; Tutorials : 15h	Language : English

Summary

The goals of this course are to understand the main characteristics about continuous and discrete time signals and the basis needed for their further processing (filtering for example).

Prerequisites

Students are supposed to have knowledge about circuit analysis with sinusoidal signals and some ideas about Fourier series representation of periodical signals. They must of course know how to calculate basic integrals (mainly exponential functions and rectangular window) and finite and infinite geometrical series.

Contents

Continuous time signals

- Fourier and Laplace transforms
- Time invariant linear systems and convolution
- Transfer functions, stability, frequency response, Bode representation, poles / zeros diagrams
- Application to physical systems (electrical, mechanical)

Discrete time signals

- Sampling theorem. Fourier equivalence of sampled signals and sequences. Practical sampling and converters. Problem of practical reconstruction (blocker effects).
- Linear systems, time invariant and non time invariant (i.e. compressor and oversampler)
- Fourier and Z transforms
- Convolution, transfer functions, stability, frequency response, poles / zero diagrams
- Convolution / product duality. Windowing.
- Frequency sampling : Discrete Fourier Transform and applications
- Introduction to filter design.

Organization

- Duration: 45 h (3 h per week, for 15 weeks)
- Approximately 40 % on continuous time signals, 60 % on discrete time signals
- Approximately 2/3 of the time will be used for formal lecturing, the remaining third being in form of tutorials (tutorial and lecture will be intertwined, as the group will be small enough to do it in the same place).

Textbook

1. B. P. Lathi, Linear Systems and Signals, Oxford Univ. Press, 2nd edition

Similar to the following courses

- IIT Chicago ECE 308
- University at Buffalo EE 303
- University of Pittsburgh ECE 1552
- Mississippi State University ECE 3443
- University of Illinois at Urbana-Champaign ECE 310
- University of Michigan at AA EECS 451 or EECS 216

	ENSEA	FAME
	Communications Systems	
US Credits : 3	Lecture : 33h, Laboratory 12h	Language : English

Summary

This course introduces analog and digital techniques for signal transmission. By the end of the course students should be able to analyze basic communication systems and specify their performances.

Prerequisites

- Fourier analysis of signals and systems
- Probability and random variables

Contents

Signals and Systems review

- Fourier series and transforms
- Linear systems theory, impulse response and transfer functions

Continuous waveform modulation systems

- Amplitude modulation : study of AM signal in time and frequency domains, AM modulator and demodulator circuits
- Angle modulation : study of FM signal in time and frequency domains, FM modulator and demodulator circuits
- Noise effects in analog modulations

Probability, radom variables and stochastic processes

- Statistical averages, mean, correlation and covariance functions
- Transmission of a random process through a linear filter, power spectral density
- Gaussian process, white Gaussian noise

Digital communication systems

- Baseband transmission of digital signals : representation of digital information, M-ary symbols, intersymbol interference, matched filter detection, eye pattern, probability of error due to noise
- Band-pass transmission of digital signals : QAM, PSK and FSK modulations

Organization

- Duration: 45 h (average of 3 h per week , during 15 weeks)
- Include 12h of laboratory (8h of measurements on real circuits with oscilloscope and spectrum analyzer, 4h of simulations of digital systems with Matlab Simulink)
- Computer projects using MATLAB software as homeworks

Textbook

Simon Haykin & Michael Moher, Communication Systems, John Wiley, 5th Edition

Similar to the following courses

- IIT Chicago
- University at Buffalo EE 483
- Georgia Tech
- University of Pittsburgh
- Mississippi State University
- University of Michigan at AA

	ENSEA	FAME
	Fundamentals of Power Engineering	
US Credits : 4	Lecture : 33h, Laboratory : 12h	Language : English

Summary

The goal of this course is to understand and to apply the basic principles involved in the design and the modelling of Power Engineering systems.

Prerequisites

- Mathematics basis including integrals, differential equations, complex numbers and matrices.
- Physics basis in Electronics (e.g. voltage, current, resistance, inductance and capacitance). Students are also supposed to have basic knowledge about electronic circuit analysis.

Contents

Lecture

- Power definitions: active and reactive power, power factor, linear and non-linear receptors.
- Magnetic circuits and coils: magnetic materials, magneto-motive force, reluctance, magnetic energy, self and mutual inductances, hysteresis and Eddy current losses, equivalent circuits.
- Three-phase systems: definitions, coupling, power measurement.
- Single and three-phase transformers: Kapp assumptions, equivalent circuits, losses and efficiency, parameter identification using no load test and short-circuit test.
- DC motors: Structure and model, operating modes and power (motor, generator), efficiency.
- Three-phase AC motors: Structures, models, equivalent circuits, power losses and efficiency.
- Power electronics: Elementary components (Diode, IGBT, FET) and design rules (association of voltage and current sources), power bridges (rectifier, chopper, inverter) and introduction to variable speed drives,
- Brief introduction to power networks and smart grid.

Labs

- Transformer (hysteresis cycle and magnetic saturation, no load test and short-circuit test, operation under resistive, inductive and capacitive load).
- Variable speed drive based on a DC motor and a controlled power bridge.
- Alternator (synchronous generator) and power generation.

Organization

- Duration: 45 h (Lecture: 3h per week for 11 weeks. Laboratory: 3 labs, 4h each).

Textbooks

Peter F. Ryff, Electric Machinery, 2nd edition, Prentice Hall International.
P.C. Sen, Principles of electric machines and power electronics, 2nd edition. John Wiley & Sons, Inc.

Similar to the following courses

- IIT Chicago ECE 319
- University at Buffalo EE 425
- Georgia Tech ECE 3070
- University of Pittsburgh ECE 1771
- Colorado School of Mines EGGN 484/485
- University of Colorado at Boulder ECEN 3170
- University of Illinois at U-C ECE 330
- Mississippi State University ECE 3414/3614
- University of Michigan at AA EECS 419

	ENSEA	FAME
	Probability and Statistics	
US Credits : 3	Lecture : 45h	Language : English

Summary

This course allows students to understand the basis principles in Probability and Statistics. The first three chapters cover basics of probability and introduce many fundamentals that are later necessary in statistical inference studies. Chapter 4 is transitional between probability and statistics and detail three statistical principles (sufficiency, likelihood and invariance) and shows how these principles are important in modelling data. Chapter 5 and 6 represent the central core of statistical inference, estimation (point and interval) and hypothesis testing. A major feature of these chapters is the division into methods of finding appropriate statistical techniques and methods of evaluating these techniques. Chapter 7 treats the theory of regression, dealing first with simple linear regression and covering regression with "errors in variables", the major purpose of regression is to explore the dependence of one variable on others.

Prerequisites

- Calculus and analytical geometry (including vector analysis)
- Usual functions. Euclidian space. Partial differentiation. Multiple integrals. Line and surface integrals. Integral theorems of vector calculus

Contents

- Elementary Probability Theory including discrete and continuous distributions :
  - Discrete Uniform Distribution, Hyper geometric Distribution, Binomial Distribution, Poisson Distribution.
  - Continuous Uniform Distribution, Exponential Distribution, Normal Distribution, Gamma Distribution, Beta Distribution
- Multiple Random Variables.
- Properties of a Random Sample:
  - Strong Law of Large Numbers.
  - Central Limit Theorem.
  - Slusky's Theorem.
- Estimation: the Likelihood Principle, Maximum Likelihood Estimators, Methods of Evaluating Estimators.
- Confidence intervals: Methods of finding interval estimators, Methods of evaluating interval estimators.
- Hypothesis Testing : Methods of finding tests, Methods of evaluating tests.
- Simple and Multiple Linear Regression.
- Applications.

Organization

- Duration: 45 h (3 h per week, for 15 weeks)

Textbook

George Casella, Roger L. Berger, Statistical Inference, Duxbury Press, 2nd edition

Similar to the following courses

- IIT Chicago MATH 474
- University at Buffalo STA 301 & 302
- Georgia Tech
- University of Pittsburgh ENGR 20
- Mississippi State University IE 4613
- University of Michigan at AA STAT 412

	ENSEA	FAME
	French Language and culture	
US Credits : 3	Lecture : 45h	Language : English and French

Summary

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

Prerequisites

No prerequisites

Contents

- Practice in the French language to gain a certain level of competency (grammar and vocabulary)
- France today in its socio-cultural-economic context (politics, cultural events, economics…)
- France from the past to nowadays (history, painting, wines and cheeses …..)

Organization

- Duration: 45 h (3h per week)
- At the beginning, a quiz of 30 minutes will be given to determine the students' French language level
- Quizzes, exercises and presentation (50%) and final exam (50%)

Textbook

Français.com beginners (CLE INTERNATIONAL)

Similar to the following courses

GENERAL EDUCATION

The French Language and Culture course is compulsory (3 c.h.)
The Electronic Circuits & Laboratory course is equivalent to 2 courses (6 c.h.)

Students can choose as many scientific courses as they like among the courses offered. However, considering the work load of each course, a maximum of 15 c.h. is recommended.