MASTER ELECTRONIC SYSTEMS FOR EMBEDDED AND COMMUNICATING APPLICATIONS

RÉSUMÉ DE LA FORMATION
Type de diplôme : Master (LMD)
Domaine ministériel : Sciences, Ingénierie et Technologies
Mention : Aéronautique et espace

ETABLISSEMENTS COACCRÉDITÉS
* INSTITUT MINES-TELECOM
* ECOLE NATIONALE DE L’AVIATION CIVILE
* INSA TOULOUSE
* ISAE TOULOUSE

PLUS D’INFOS
Crédits ECTS : 120
Niveau d’étude : BAC +5
Public concerné
* Formation initiale
* Formation continue
Nature de la formation : Parcours
Stage : Obligatoire (6 months)

EN SAVOIR PLUS

Présentation
2 internships (6 weeks + 6 months) in a laboratory or a company. One individually tutored project in a research team (100h tutoring), plus several project with small groups of students.

Objectifs
Knowledge of analog and digital electronic systems. Knowledge of the embedded systems from the hardware point of view. Antenna and RF systems theory and applications. Signal and image processing in the communications and aeronautics systems. Power management of embedded and autonomous systems.

Savoir faire et compétences
To design electronic embedded systems. To design communicating systems in the radiofrequency domain. To Design power management for embedded systems. To develop signal and image processing in the context of communications and aeronautics.
Contenu de la formation

PhD in the domains of electronics, signal processing, communications, aeronautics and space.

Organisation de la formation

MASTER ELECTRONIC SYSTEMS FOR EMBEDDED AND COMMUNICATING APPLICATIONS M1
MASTER ELECTRONIC SYSTEMS FOR EMBEDDED AND COMMUNICATING APPLICATIONS M2

Stages

2 internships (6 weeks + 6 months) in a laboratory or a company. One individually tutored project in a research team (100h tutoring), plus several project with small groups of students.

Conditions d'accès

Bachelor of Science or equivalent in the domain of electronic engineering.

Poursuite d'études

Manufacturers of electronic devices in the aeronautic context. Manufacturers in the hardware for embedded systems. Main companies in the aeronautics and automotive fields

Insertion professionnelle

Manufacturers of electronic devices in the aeronautic context. Manufacturers in the hardware for embedded systems. Main companies in the aeronautics and automotive fields

Composante

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

Lieu(x) de la formation

Toulouse

Contact(s) administratif(s)

Contact master ESECA
master-eseca @ univ-toulouse.fr
MASTER ELECTRONIC SYSTEMS FOR EMBEDDED AND COMMUNICATING APPLICATIONS M1

PLUS D'INFOS

Crédits ECTS : 60

Organisation de la formation

- M1 Electronic Systems for Embedded & Communicating Appl.
  - Parcours Normal - M1 ESECA Semestre 7
    A choix: 1 Parmi 1 :
      - Parcours Standard sem 7 ESECA
      - UE UE Social Science & Culture sem 7
        - Matière French (FLE) M1 ESECA semestre 7
        - Matière Conferences on aeroautics - sem 7
        - Matière Communication
        - Matière Sport - M1 ESECA
      - UE UE Math. - M1 ESECA
        - Matière Maths Fourier Analysis
          Objectifs
          
          Become familiar with the basic notion of signals, Fourier series and Fourier Transform. Master the skills to do Fourier analysis of periodic and aperiodic signals in most electronic applications.

          To have basic ideas of vector analysis and orthogonal coordinates systems.

          Description
          1. Fourier Series: Introduction to signal - Sinewave - Fourier series - Fourier series for conventional signal - Complex form of Fourier series - Electrical signal applications
          2. Fourier Transform: From periodic to aperiodic signal: Fourier Transform - Fourier transform of some conventional signals - Basic theorems of Fourier transform - Electrical waveforms and spectra - Applications in electronics - Discrete Fourier Transform
3. **Vector Analysis**: Introduction - Vector Algebra - Theorem of Vector Algebra - Cartesian coordinates system - Orthogonal coordinate systems - Differential operator on vector field - Useful theorems on vector analysis

- **Matière Maths - Complex variable - Vector analysis**

  **Objectifs**

  Become familiar with complex variable, complex plane, complex derivative and complex integration. Master the skills to do complex integration and real function integration by using residue theorem. Become familiar with Laplace transform for continuous linear systems and Z transform for discrete linear systems.

  **Description**

  1. Complex Plane, complex variables and complex functions
  2. Derivative of complex function. Analytic function
  3. Integral of complex function.
  4. Residue Theorem
  5. Laplace Transform
  6. Z transform

  **Bibliographie**

  1. *Complex Variables*, Robert B. Ash and W. P. Novinger, Dover Publication
  3. *Cours d’Analyse (in French)*, S. D. Chatterji, Presse Polytechniques et Universitaires romandes

- **Matière Maths Probability / Statistics**

  **Objectifs**

  Become familiar with basic notions of random events and mathematical tools for their modelling. Master the skills to study discrete and continuous random variables and be familiar with the most used probability laws and their applications on modelling of both discrete and continuous random events.

  **Description**

  1. Basic Concepts
  2. Random variables
  3. Expectation
  4. Conditional probability
  5. Initiation to reliability

  **Bibliographie**


- **UE Programming**

  - **Matière Basis of Programming / Matlab**
  
  - **Matière C programming**
Pré-requis nécessaires
Students must know how to implement code in any programming language

Objectifs
- To apprehend the algorithmic basic concepts and
  the basic concepts of the structured programming
- Study fundamental notions of C programming

Matière Microprocessor

Pré-requis nécessaires
Prerequisites:
- C programming
- Assembly language

Objectifs
- Handle C programming for embedded system
- Handle microprocessor/micro-controller architecture
- Be autonomous on a project

Description
This course will be divided in three section: lessons, labs and project

During labs students will discover the architecture of PIC processor and will implement basic functions in C.

During the project, student will implement an UART communication with an RFID detector. The main objective is to control a step motor. (which represent a door) by a tag RFID.

Méthode d'enseignement
En présence

Langue d'enseignement
English

.. UE UE Analog Electronics

- Matière Circuits

Pré-requis nécessaires
semi-conductor devices, filtering (1st & 2nd order low-pass filters) ; Kirchhoff's Current Law,

Compétences visées
Be able to design a stable closed-loop circuit by optimising its gain-bandwidth product

Méthode d'enseignement
En présence
Langue d’enseignement
Anglais

Bibliographie

- Matière Project Analog Electronics

Pré-requis nécessaires
Circuits course and Analog electronics labwork

Objectifs
Objectives:
At the end of Analog electronics project, the student will be able to:

- Use a spectrum analyser
- Describe the basic functions of a heterodyne receiver and characterize these functions
- Make some experiments with a SDR transceiver (transmitter and receiver) in order to “discover how ‘Powerfull’ SDR is

Description
These courses and labworks are an introduction to the basics of analog and digital data transmission:
- AM, FM modulation
- I/Q modulation
- Features of a heterodyne receiver
- Introduction to SDR (Software Defined Radio) and the IoT (Internet of Things)

- Matière Analog Electronics Pratical

Pré-requis nécessaires
Circuits course

Description
At the end of these electronics labworks, the student will be able to:

- Characterize a passive circuit by its transient response and its frequency response (first and second order circuits).
- Design and implement a filter
- Implement and characterize linear and non linear circuits with operational amplifier components (amplifiers, active filters, comparators, astable circuits, …).

Identify the technical limits of these components in order to learn how to choose them for a specific application

- Matière Semic-conductor devices

- Matière Filtering
Pré-requis nécessaires

None

Objectifs

The aim of this course is to learn the design methods and synthesis techniques for analog filters.

Description

This course falls into seven parts:

- Analog front-end architecture: Heterodyne and super heterodyne architectures. Role and specifications of the filter in the system.
- Determination of a partially known stable filter function: How can we find single or a family of stable function of with knowledge of part of the electrical response (either magnitude or phase, real or imaginary parts, even or odd parts).
- Synthesis techniques to determine LC networks: Cauer, Foster and Darlington methods.
- Approximation functions: Butterworth, Tchebychev.
- Lowpass filter prototype: design method.
- Frequency transformations: bandpass-, highpass-, stopband-to-lowpass prototype transformations. LC networks transformations.
- Active filters

· Matière Transmission lines

· UE UE Digital Electronics

· Matière Digital electronics

· Matière VHDL - M1 ESECA

Pré-requis nécessaires

Prerequisites:

- Basis of analog and digital electronic (transistor, Flip-flop, LUT etc...)

Objectifs

- Handle VHDL material description language
- Handle the architecture of an FPGA
- Be Autonomous on a project

Compétences visées

- VHDL programming

Méthode d'enseignement

En présence
- Parcours PIM sem 7 - M1 ESECA
  - UE UE PIM Commun
  - UE UE PIM N7
    - Matière Ligne de Transmission
    - Matière Circuits RF passifs et actifs
    - Matière Antennes
    - Matière Programmation C

- M1 ESECA Semestre 8
  - UE UE Social Science &Culture sem 8
    - Matière Sport semestre D
    - Matière Projet Industriel
      Responsable(s)
      PRIGENT GAETAN
    - Matière Langues M1 ESECA
      - Matière Anglais 2EN semestre 8
      - Matière LV2 M1 ESECA
### Objectifs

The aim of this course is to provide students ability to:

- design an optical link for communication
- design a photodetection system
- design a light emission system with an LED or a laser diode

### Description

Fiber optic based communication systems represent the large majority of communication links worldwide in long or mid-range distances.

Beyond the channel that is the optical fibre, these systems require the use of dedicated components where the interaction between the electrons and the photon of the transmitted light is the major phenomenon.

Mastering of these interactions leads to design communications link with performances far beyond the ones of wireless or copper based communications.

The aim of this course thus is the study of the optical fibre properties, the emission components (LED and laser diodes) and the detection components (photodiodes). The global architecture of an optical communication link is given as well as the general principle of sensing using interferometric optical devices.

### Bibliographie

- Être capable d'analyser une chaine de transmission numérique de base (bloc modulateur/démodulateur, canal à bruit additif blanc et Gaussien) en termes d'efficacité spectrale et d'efficacité en puissance.

- Être capable d'implanter numériquement des chaînes de transmission numérique de base, de les comparer et de les optimiser en termes d'efficacité spectrale et d'efficacité en puissance.

**Description**

Cet enseignement aborde les points suivants :

1- Rôle des éléments d'une chaîne de communication permettant de transmettre une information numérique.

2- Génération d'un signal à partir d'une information numérique à transmettre (modulateur numérique) :

   - en bande de base

   - sur fréquence porteuse (modulations de type ASK, PSK, QAM),

   - notion d'efficacité spectrale.

3- Modélisation simple du canal de propagation.

4- Mise en place d'un démodulateur numérique optimisé :

   - Notion d'efficacité en puissance,

   - Notion d'interférence entre symboles et critère de Nyquist,

   - Filtrage adapté.

5- Calcul de taux d'erreur binaire.

6- Notion d'enveloppe complexe et de chaîne passe-bas équivalente pour les transmissions sur fréquence porteuse.

7- Exemple de chaîne de transmission numérique de base : couche physique du DVB-S.

**Volume horaire**

4 cours, 6 TPs

**Responsable(s)**

THOMAS Nathalie  
Nathalie.Thomas@enseeiht.fr  
Tel. 2236

**Méthode d'enseignement**

En présence

**Langue d'enseignement**

Anglais

**Bibliographie**

- M. Joindot, A. Glavieux, Introduction aux communications numériques, Dunod

- J.C. Bic, D. Dupontel, J.C. Imbeaux, Eléments de communications numériques, Dunod

**Matière Pratical Hyper / Opto**

**Matière Laser and optical fiber sensing techniques**

Pré-requis nécessaires

Optoelectronics
Compétences visées

Be capable to do a critical analysis of the different operating principles of optical measuring sensors for displacement, position, thickness, velocity, profile and 2D/3D dimension with laser-based devices.

Be able to select the correct sensor technology for your specific measurement task.

Méthode d'enseignement
En présence

Langue d'enseignement
English

· UE UE RF
  · Matière Antennas
  · Matière Passive RF
  · Matière Active RF circuits
  · Matière MEMS
  · Matière Hyper Frequence Project

· UE UE Signal and Image
  · Matière Signal processing
  · Matière Digital Sign.Proc.
  · Matière Image processing
  · Matière Signal & Image processing project

Composante

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications
MASTER ELECTRONIC SYSTEMS FOR EMBEDDED AND COMMUNICATING APPLICATIONS M2

PLUS D'INFOS

Crédits ECTS : 60

Organisation de la formation

· M2 Electronic Systems for Embedded & Communicating Appli.
  - M2 ESECA Semestre 10
    - UE M2 ESECA Soutenance PFE
  - A choix: 1 Parmi 1 :
    - M2 ESECA Circuits Intégrés pour Systèmes Embarqués Sem. 9

- UE Sciences Humaines et Sociales
  - Matière Soutenance de stage
  - Matière Langue M2 ESECA (option ICES et SIP) semestre 9
  - Matière Relations entreprises
  - Matière Métiers et fonctions de l'Ingénieur dans l'industrie

- UE Architecture des systèmes mixtes
  - Matière VHDLAMS
  - Matière Internet des objets
  - Matière Architecture, mise en oeuvre et fiabilité des systèmes embar
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<td>Responsable(s) BONY FRANCIS REBOLLO TONY</td>
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<td>Technologie du silicium</td>
<td>Responsable(s) LECESTRE AURELIE</td>
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<td>Responsable(s) TAP -BETEILLE HÉLÈNE MOUTAYE EMMANUEL</td>
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· Choix option Analogique ou Numérique

A choix: 1 Parmi 1 :

· Option Analogique

· Matière Circuits Intégrés Analogiques

· Matière Intégration de Chaines d'Instrumentation

· Matière ASIC analogique

Pré-requis nécessaires

Knowledge of the basic concepts related to the transistor main characteristics (parameters, technology, MOSFET / BJT) as well as the basics of the analog design (common emitter/collector stage, input differential stage, push-pull, etc…).

Objectifs

At the end of the part dedicated to the design of the integrated linear regulator at the transistor level, the students can make the right choices regarding the topology improvement of the built-in analog functions due to the fact that they are able to analyze the main behavior of an analog circuit to determine its overall performances.

After the second part dedicated to the layout of the circuit using Cadence™ tools, the students will be able to draw the masks of an analog integrated circuit and make the relevant choices by showing that they master the concepts of component matching, required to implement specific properties such as the ratio of the transistor sizes or that of passive components.

Compétences visées

- Know how to design and implement a linear regulator using a submicron CMOS technology,
- Have a deep understanding of the analog design flow,
- Be able to make the right choices concerning the transistor-level topology improvement,
- Obtain a good understanding the method of design of the analog circuit and the related Layout recommendations.

Description

The project is divided into three main parts:

-1- The design at the transistor-level of the circuit using very simple 1st-order models of MOSFET transistors.

-2- Perform the circuit validation using Pspice/Spectre simulator involving the accurate technology parameters. First, several temperature cases have to be considered and finally all the worst-case parameters have to be taken into account to validate the sizing of the transistors. The influence of the dispersions is also highlighted by Monte Carlo analysis.

-3- Draw the layout of the circuit using Cadence™ tools with respect to the basic rules of component matching.

Volume horaire

3.5 HC + 35 HBE

Responsable(s)

Cousineau Marc
Marc.Cousineau@enseeiht.fr
Tel. 2431

Méthode d'enseignement

En présence
**Langue d'enseignement**
Both English and French

**Bibliographie**

- W. Sansen, “Advanced Analog IC Design Courses”, KU Leuven
- K. Bult, “Transistor Level Analog IC Design Courses”, EPFL

**Option Numérique**

**Matière Projet ASIC, Traitement du Signal**

**UE Systèmes embarqués**

**Matière Convertisseur d'Energie DC/DC**

**Pré-requis nécessaires**

Knowledge of the basic concepts related to Kirchhoff laws and the MOSFET transistor (static and dynamic characteristics, Spice model level 1).

**Objectifs**

At the end of the first part of the training dedicated to the analysis of the SMPS topology analysis, the students will be able to master correctly all the equations and the main notions attached to the study of a DC/DC converter by showing that they are able to analyze the state-variable waveforms in steady-state to determine the performances of the system.

After the second part dedicated to the study of the voltage and current control loops, the students will be able to determine the type of controller required to regulate the state-variables of the system by showing that they are able to compute the pole and zero of the open-loop transfer function when it is necessary to insure the stability of a SMPS-type DC/DC converter.

**Compétences visées**

- understand the principles of lossless energy transfer using SMPS topologies,
- know the different architectures used to provides an output voltage higher or lower than the input voltage : Buck converter, Boost converter, Buck-boost converter, SEPIC converter.
- be able to find the analytical expression of each characteristic of the converter using a waveform analysis method,
- understand the different method used to regulate the output voltage value for any type of load or any value of input voltage,
- be able to compute the poles and zeros of the controller in order to implement an unconditional stable control loop for the output voltage regulation.
- be able to understand the datasheet of an SMPS.
Description

The course is divided into 3 distinct parts:

- 1) the study of the Buck converter topology (waveform analysis, CCM vs DCM, basic voltage control loop),

- 2) the study of the Boost converter topology (waveform analysis, CCM vs DCM, basic voltage control loop including a peak-current detection method)

- 3) the small-signal analysis of a Sample-Mode-Power-Supply: introduction to the state-variable analysis method, transfer function identification, design of the controller to insure the stability of the regulated system.

Practical work session using Cadence-Pspice simulator helps to illustrate the different concepts discussed in the course, namely: understand the shape of the several waveforms observed with the Buck converter, be able to design of a simple voltage control loop and measure the phase margin.

Volume horaire
8.75 HC + 10.5 HBE

Responsable(s)
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Méthode d’enseignement
En présence

Langue d’enseignement
Anglais

Bibliographie


Unitrode Application Notes U-97, U-93, U-111, U-140 and DN-62.

- Matière Drivers et Intégr. - Transf. Intégrés

Pré-requis nécessaires

Knowledge of the basic concepts related to the power transistor main characteristics (parameters, technology, MOSFET / IGBT) as well as the basics about Switch Mode Power Supply.

Objectifs

At the end of the first part of the training dedicated to the analysis of the power transistor switching mechanisms, the students will be able to determine correctly the dynamic performance of a complete eletrical system involving the Driver circuit in its environment by showing that they are able to analyze waveforms when it is necessary to determine the overall losses associated with the switchings.

After the second part dedicated to the study of the disturbances due to the presence of parasitic components, the students will be able to read a data sheet and make relevant choices by showing that they master the concepts related to Driver circuits and its EMC issues when it is necessary to implement the switching-cells of a SMPS-type converter.

Compétences visées

- Know how to read the datasheet of a Driver circuit, to estimate the losses related to the control circuit,

- Have a depth knowledge of the switching-cell behavior,

- Be able to make the right choices for the components in the design of a power board,
- Obtain a good understanding of the design rules related to the PCB drawing to minimize EMI issues due to the switchings.

Description

The course is divided into 3 distinct parts:

- 1) the behavior of a MOSFET or IGBT transistor during a turn-on event is analysed in detail (gate-to-source $V_{gs}$ vs gate charges $Q_g$, behavior of the capacitors $C_{gs}$, $C_{gd}$, $C_{dd}$, the Miller plateau, $dl/dt$ and $dV_{ds}/dt$ equations),

- 2) the peripheral functions of the driver: bootstrap circuitry, charge pump, isolated power supplies, transmission of isolated control signal and immunity to dv/dt, synchronous rectification, dead-time notion, influence of parasitic components (inductive and capacitive) during a switching event,

- 3) the physical implementation of the Driver circuit (IC level) and study of the resonant topologies (principle and efficiency analysis).

Practical work session using Cadence-Pspice simulator helps to illustrate through waveform analysis the several concepts covered in the course, namely: the turn-on and turn-off events, the design of a charge-pump circuit, the behavior of a resonant driver topology.

Volume horaire
5.25 HC + 7 HBE

Responsable(s)
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Tel. 2431

Méthode d’enseignement
En présence

Langue d’enseignement
Anglais

Bibliographie

A. D. Pathak, « MOSFET/IGBT Drivers Theory And Applications » - IXYS Colorado.


<table>
<thead>
<tr>
<th>Responsable(s)</th>
<th>PRIGENT GAETAN</th>
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<td>Pré-requis nécessaires</td>
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Objectifs

Développer ses compétences en communication professionnelle en effectuant des tâches de communication courantes, écrites et orales, en anglais.

Compétences visées

1) Rédiger un abstract de 2000 mots en anglais

2) Rédiger un rapport sur son stage de 2ième année / M1 en anglais.

3) Présenter son projet longue de 3ième année / M2.

Description

1 semestre de 12 séances interactives et hebdomadaires.

Volume horaire

21 heures

Méthode d'enseignement

En présence

Langue d'enseignement

Anglais

Bibliographie

Abstracts and the writing of abstracts


· Matière Conduite de projet

· UE Radar et Systèmes

· Matière Signal Radar

· Matière Equipement Radar

· Matière Réseaux communicants

Responsable(s)

TAO JUNWU

· UE Physique Appliquée 1

· Matière Modèles Multiphysiques - COMSOL

Responsable(s)
TAO JUNWU

- Matière CEM
- Matière Antennes réseaux
- Matière Théorie de la diffraction
- Matière Propagation réelle

- M2 ESECA Signal and Image Processing Semestre 9

- UE UE Modélisation et Représentation des signaux
  - Matière Représentation et Analyse des Signaux II
    Responsable(s)
    OBERLIN THOMAS
  - Matière Représentation et Analyse des Signaux
  - Matière Codage de source, Application à l’audio
  - Matière Estimation - Détection
  - Matière Classification et Reconnaissance des Formes

- UE UE Traitement des signaux numériques
  - Matière Traitement Numérique du Signal 2
  - Matière Processeurs de Traitement du Signal

- UE UE Technique avancée du traitement du signal
  - Matière Traitement d’antennes
  - Matière Traitement adaptatif
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<td>Matière Langue M2 ESECA (option ICES et SIP) semestre 9</td>
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<td>Matière Relations entreprises</td>
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<td>Matière Métiers et fonctions de l'Ingénieur dans l'industrie</td>
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**Composante**

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications
MASTER ELECTRONIC SYSTEMS FOR EMBEDDED AND COMMUNICATING APPLICATIONS M2

PLUS D’INFOS

Crédits ECTS : 60

Organisation de la formation

- M2 Electronic Systems for Embedded & Communicating Appli.
  - M2 ESECA Semestre 9
    - UE UE Social Science & Culture sem 9
      - Matière French (FLE) sem 9
      - Matière English sem 9
      - Matière Internship presentation
    - Matière Research project
    - Matière Conferences on aeronautics sem 9
    - Matière Relation with enterprises
  - UE UE Embedded Systems
    - Matière Synthèse numérique
      Responsible(s)
      BONY FRANCIS
      REBOLLO TONY
    - Matière System on Chip
    - Matière Projet ASIC, Traitement du Signal
· Matière Equipment RF

· Matière Dimensionnement Charge Utile

· Matière Architectures, interfacing and reliability of ES

· Matière Mobile autonomous platform project

· UE UE Power Management

· Matière Convertisseur d’Energie DC/DC

Pré-requis nécessaires

Knowledge of the basic concepts related to Kirchhoff laws and the MOSFET transistor (static and dynamic characteristics, Spice model level 1).

Objectifs

At the end of the first part of the training dedicated to the analysis of the SMPS topology analysis, the students will be able to master correctly all the equations and the main notions attached to the study of a DC/DC converter by showing that they are able to analyze the state-variable waveforms in steady-state to determine the performances of the system.

After the second part dedicated to the study of the voltage and current control loops, the students will be able to determine the type of controller required to regulate the state-variables of the system by showing that they are able to compute the pole and zero of the open-loop transfer function when it is necessary to insure the stability of a SMPS-type DC/DC converter.

Compétences visées

- understand the principles of lossless energy transfer using SMPS topologies,
- know the different architectures used to provides an output voltage higher or lower than the input voltage : Buck converter, Boost converter, Buck-boost converter, SEPIC converter.
- be able to find the analytical expression of each characteristic of the converter using a waveform analysis method,
- understand the different method used to regulate the output voltage value for any type of load or any value of input voltage,
- be able to compute the poles and zeros of the controller in order to implement an unconditional stable control loop for the output voltage regulation.
- be able to understand the datasheet of an SMPS.

Description

The course is divided into 3 distinct parts :
- 1) the study of the Buck converter topology (waveform analysis, CCM vs DCM, basic voltage control loop),
- 2) the study of the Boost converter topology (waveform analysis, CCM vs DCM, basic voltage control loop including a peak-current detection method)
- 3) the small-signal analysis of a Sample-Mode-Power-Supply: introduction to the state-variable analysis method, transfer function identification, design of the controller to insure the stability of the regulated system.
Practical work session using Cadence-Pspice simulator helps to illustrate the different concepts discussed in the course, namely: understand the shape of the several waveforms observed with the Buck converter, be able to design of a simple voltage control loop and measure the phase margin.

**Volume horaire**
8.75 HC + 10.5 HBE

**Responsable(s)**
COUSINEAU Marc
Marc.Cousineau@enseeiht.fr
Tel. 2431

**Méthode d’enseignement**
En présence

**Langue d’enseignement**
Anglais

**Bibliographie**
Unitrode Application Notes U-97, U-93, U-111, U-140 and DN-62.

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**- Matière Drivers et Intégr. - Transf. Intégrés**

**Pré-requis nécessaires**
Knowledge of the basic concepts related to the power transistor main characteristics (parameters, technology, MOSFET / IGBT) as well as the basics about Switch Mode Power Supply.

**Objectifs**
At the end of the first part of the training dedicated to the analysis of the power transistor switching mechanisms, the students will be able to determine correctly the dynamic performance of a complete electrical system involving the Driver circuit in its environment by showing that they are able to analyze waveforms when it is necessary to determine the overall losses associated with the switchings.

After the second part dedicated to the study of the disturbances due to the presence of parasitic components, the students will be able to read a data sheet and make relevant choices by showing that they master the concepts related to Driver circuits and its EMC issues when it is necessary to implement the switching-cells of a SMPS-type converter.

**Compétences visées**
- Know how to read the datasheet of a Driver circuit, to estimate the losses related to the control circuit,
- Have a depth knowledge of the switching-cell behavior,
- Be able to make the right choices for the components in the design of a power board,
- Obtain a good understanding of the design rules related to the PCB drawing to minimize EMI issues due to the switchings.

**Description**
The course is divided into 3 distinct parts:

- 1) the behavior of a MOSFET or IGBT transistor during a turn-on event is analysed in detail (gate-to-source $V_{gs}$ vs gate charges $Q_g$, behavior of the capacitors $C_{gs}$, $C_{gd}$, $C_{ds}$, the Miller plateau, $dI/dt$ and $dV_{ds}/dt$ equations),
2) the peripheral functions of the driver: bootstrap circuitry, charge pump, isolated power supplies, transmission of isolated control signal and immunity to dv/dt, synchronous rectification, dead-time notion, influence of parasitic components (inductive and capacitive) during a switching event,

3) the physical implementation of the Driver circuit (IC level) and study of the resonant topologies (principle and efficiency analysis).

Practical work session using Cadence-Pspice simulator helps to illustrate through waveform analysis the several concepts covered in the course, namely: the turn-on and turn-off events, the design of a charge-pump circuit, the behavior of a resonant driver topology.

Volume horaire
5.25 HC + 7 HBE

Responsable(s)
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Méthode d’enseignement
En présence

Langue d’enseignement
Anglais

Bibliographie
A. D. Pathak, « MOSFET/IGBT Drivers Theory And Applications » - IXYS Colorado.


- Matière EMC of Integrated Circuits

- UE UE Radar and remote sensing

- Matière Signal Radar

- Matière Remote sensing project

- Matière RADAR equipment

- UE RF/OPTO

- Matière Composants et Circuits optoélectroniques en HF

Responsable(s)
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- Matière Project Embedded optical links
- Matière Signal for telecommunication
- Matière Space telecoms
- M2 ESECA Semestre 10
- UE UE Soutenance PFE semestre 10