230675 - EDIS - Edison: Energy Management for Distributed and Integrated Systems

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019).
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN INFORMATION AND COMMUNICATION TECHNOLOGIES (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 5  Teaching languages: English

Teaching staff
Coordinator: EDUARD ALARCON
Others: ALBERTO POVEDA

Degree competences to which the subject contributes

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology
- Lectures
- Exercises
- Other activities
- Extended answer test (Final Exam)

Learning objectives of the subject

Learning objectives of the subject:
The aim of this course is to introduce the students in several techniques of modelling, design and control of energy management architectures, particularly in an IC context, designing its subsystems and related modulation, control and management policies. The course focuses on energy management and supply subsystems specifically targeting communication and computing applications.
Requisites: Students coming from academic studies other than B. Sc. Electronics Systems Engineering or equivalent ones, should have successfully passed the examinations of the bridging courses "Control" and "POT".

Learning results of the subject:
- Ability to design energy management architectures, particularly in an IC context
- Ability to design energy management subsystems, including circuit and model aspects
- Ability to understand and apply energy management architectures for distributed and integrated applications
- Ability to understand and apply energy management subsystems, particularly in an IC context
- Ability to understand and apply modulations, control and energy management policies
# 230675 - EDIS - Edison: Energy Management for Distributed and Integrated Systems

- Ability to design integrated and distributed energy management systems in various ICT applications

## Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 26h</th>
<th>20.80%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>13h</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>86h</td>
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</tbody>
</table>
# Content

## 1. Introduction to energy management

**Learning time:** 7h  
Theory classes: 2h  
Self study : 5h

**Description:**  
- Basic concepts. Energy processing vs signal processing  
- Energy processing architecture: source, processor and load  
- Current applications

## 2. Efficient energy conversion subsystems

**Learning time:** 21h  
Theory classes: 6h  
Self study : 15h

**Description:**  
- Converter classification: linear converters, switched capacitor converters, switching power converters  
- Switching power converters: fundamentals of synthesis and design-oriented analysis  
- Switching power regulators  
- Power processing modular architectures

## 3. Batteries and other energy sources

**Learning time:** 13h  
Theory classes: 4h  
Self study : 9h

**Description:**  
- Classification of batteries  
- Battery modelling  
- Other energy sources: Fuel cells, supercapacitors, photovoltaic cells

## 4. Energy management in battery-operated mobile telephone portable terminals

**Learning time:** 20h  
Theory classes: 6h  
Self study : 14h

**Description:**  
- Energy management within the system-on-chip architecture  
- Power converter miniaturization guidelines  
- Improved efficiency techniques: adaptive power management for DSP and RF amplifiers  
- On-chip energy distribution networks
### 5. Powering microprocessors

**Description:**
- Voltage regulator modules (VRM). Specifications.
- Decoupling issues
- Modular powering architectures for multi-processor systems.
- Other issues: UPS (Uninterruptible power supplies) and PFC (Power factor correction) circuits

**Learning time:** 7h  
Theory classes: 2h  
Self study: 5h

### 6. Bus architectures for energy distribution in satellites

**Description:**
- Energy management architectures for aerospace applications.
- Effect of satellite orbit
- Energy bus classification: non-regulated, hybrid and regulated bus

**Learning time:** 7h  
Theory classes: 2h  
Self study: 5h

### 7. Other applications

**Description:**
- Techniques for efficient DC to RF power conversion
- Efficient switching power audio amplifiers
- Power issues in line drivers
- Energy Harvesting circuits and systems

**Learning time:** 13h  
Theory classes: 4h  
Self study: 9h

### 8. Laboratory 1

**Description:**
Circuit-level simulation of a voltage regulator module (VRM) powering a microprocessor

**Learning time:** 13h  
Laboratory classes: 5h  
Self study: 8h
### Planning of activities

#### LECTURES

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>9. Laboratory 2</td>
<td>Experimental characterization of the energy management system in a Li-Ion battery-operated mobile phone</td>
</tr>
<tr>
<td>10. Laboratory 3</td>
<td>CMOS on-chip power management for RF PA</td>
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</tbody>
</table>

#### EXERCISES

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Description</th>
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<tbody>
<tr>
<td>-</td>
<td>Exercises to strengthen the theoretical knowledge.</td>
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</tbody>
</table>

#### OTHER ACTIVITIES

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
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<tr>
<td>-</td>
<td>Numerical simulation homework</td>
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#### EXTENDED ANSWER TEST (FINAL EXAM)

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
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<tbody>
<tr>
<td>-</td>
<td>Final examination.</td>
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### Qualification system

- Final examination: from 60% to 70%
- Exercises: from 30% to 40%
Bibliography

Basic:


Complementary:


