Learning objectives of the subject:

The aim of this course is to introduce the students in several techniques of modelling, design and control of power processing systems for regulation, wide-band amplification and waveform generation in different 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 derive state models of switching power converter circuits.
- Ability to design and verify the features, by numerical simulation, of state linear controllers for switching power converters in amplification, regulation and waveform generation applications.
- Ability to identify the design restrictions involved in the digital implementation of continuous time controllers for switching power converters.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong> 125h</td>
<td>39h</td>
<td>0h</td>
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## Content

<table>
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<tr>
<th>Section</th>
<th>Learning time:</th>
<th>Description:</th>
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</table>
| **1. Introduction to power processing systems** | 10h | Theory classes: 3h  
Self study: 7h |

**Description:**
- Circuit elements in high-efficiency power processors
- Power conversion types
- Switching power converters
- Functionalities and control requirements: regulation, amplification and waveform generation.

| **2. Switching converters modelling** | 25h | Theory classes: 7h  
Self study: 18h |

**Description:**
- State-space description of dynamical systems
- Dynamical systems classification (linear and nonlinear systems, time-varying and time-invariant systems, SISO and MIMO systems)
- State-space models of switching power converters: nonlinear and linearized models.  
  - Steady-state behaviour. Equilibrium points.  
  - Linearized dynamical behaviour: transfer functions

| **3. State-space linear control techniques in switching power converters** | 44h | Theory classes: 14h  
Self study: 30h |

**Description:**
- Eigenvalues. Stability analysis.  
- Output feedback.  
- State feedback. Pole placement design through Ackermann's formula  
- Discrete-time control: analysis and constraints. Implementation issues
### 4. Control applications in power electronics

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 46h</th>
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<tbody>
<tr>
<td>- Output feedback and state feedback in switching power regulators</td>
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<td>- Control of grid-connected inverters</td>
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<td>- Power factor correction and battery chargers.</td>
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<tr>
<td>- Wide-band amplifiers</td>
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<td>- Current control for switching power regulators</td>
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<td>Theory classes: 15h</td>
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<td>Self study: 31h</td>
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### Planning of activities

#### LECTURES

#### EXERCISES

**Description:**
Exercises to strengthen the theoretical knowledge.

#### OTHER ACTIVITIES

**Description:**
Numerical simulation homework

#### EXTENDED ANSWER TEST (FINAL EXAM)

**Description:**
Final examination.

### Qualification system

Mid course exam (50%)  
Final exam (50%)
Bibliography

Basic:


Complementary: