

EE-465

**Industrial electronics I**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA1, MA3	Opt.
Energy Science and Technology	MA1, MA3	Opt.
Energy minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

The course deals with the control of grid connected power electronic converters for renewable applications, covering: converter topologies, pulse width modulation, modelling, control algorithms and controllers (PID and PR), coordinate frame transformations, grid monitoring and synchronisation (PLL).

**Content****Introduction**

Power electronic technologies for renewable energy generation, with emphasis on the photovoltaic applications.

**Power electronic converters**

Requirements, topologies, operating principles, pulse width modulation methods, space vectors, modeling and control.

**Grid monitoring and synchronization**

Single-phase and three-phase applications, phase locked loops, grid filters, power quality, balanced and unbalanced grid conditions.

**Control synthesis**

Continuous and discrete time systems, sampling, discretization, cascaded control loops, PID and PR regulators, coordinate frame transformations, tuning, passive and active damping.

**Keywords**

Modeling, Control, Power Electronic Converters, Power Systems

**Learning Prerequisites****Required courses**

Control theory, Power Electronics, Power Systems

**Recommended courses**

EE-365 Power Electronics

**Important concepts to start the course**

Laplace Transform, Z-Transform, Power electronic converters, control synthesis

**Learning Outcomes**

By the end of the course, the student must be able to:

- Select appropriately power electronic converters for given application

- Derive mathematical models
- Synthesize control structures for different applications
- Prove stability and dynamic performances

### Transversal skills

- Use a work methodology appropriate to the task.

### Teaching methods

Slides, Blackboard, PLECS examples, Exercises based on the modeling and simulations using PLECS, Reporting

### Expected student activities

Attendance of lectures; Completing exercises; Writing reports based on the exercises, Proactiveness

### Assessment methods

Students are expected to write 4 short reports, during a semester, related to their laboratory exercises. These reports will be graded and contribute to 40% of the final grade.

Oral exam at the end of the course is the open book exam (20 minutes preparation + 20 minutes examination). It contributes with 60% to the final grade.

### Supervision

Assistants                      Yes

### Resources

#### Bibliography

**Grid Converters for Photovoltaic and Wind Power Systems**, Remus Teodorescu, Marco Liserre, Pedro Rodriguez, ISBN: 978-0-470-05751-3, Wiley

**Grid-Side Converters Control and Design**, Slobodan N. Vukosavic, ISBN 978-3-319-73278-7, Springer

#### Ressources en bibliothèque

- [Grid converters for photovoltaic and wind power systems / Teodorescu](#)
- [Grid-Side Converters Control and Design / Vukosavic](#)

#### Notes/Handbook

Lectures, exercises and solutions are available on the Moodle

#### Moodle Link

- <https://go.epfl.ch/EE-465>

### Prerequisite for

EE-565 Industrial Electronics II