

Power Electronics

ELEC-E8412 Power Electronics, 5 ECTS

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Who Are We?

- **Lectures**

Professor Edris Pouresmaeil (edris.pouresmaeil@aalto.fi)

- **Exercises**

Farrukh Zeb (farrukh.zeb@aalto.fi)

- **Simulation assignments**

Mobina Pouresmaeil (mobina.pouresmaeil@aalto.fi)

Course Objectives

At the end of this course, you will be able to:

- Describe the role of power electronics in various applications
- Describe the operation of Power Electronic Devices (Diode, Thyristor, MOSTFET, and IGBT)
- Analyze the basic converter topologies (**buck, boost, buck-boost, voltage source inverters**) using the switching power pole as the building block
- Analyze operation of the half-wave and the full-wave uncontrolled and controlled rectifiers
- Analyze operation of the buck, boost, and buck-boost converters in steady state and continuous conduction mode
- Use **pulse-width modulation** (PWM) to synthesize the desired output voltage of the basic converter topologies
- Analyze **3-phase** converter waveforms (currents, phase and line-line voltages, common mode voltage, power, reactive power, harmonics)

Course Format

Schedule is Available in the MyCourses Portal

- Lectures 12x2 h, Fridays 8:15 -10:00, TUAS-building, AS1 - 1018, Maarintie 8.
- Exercises 7x2 h (Thursday 10:15-12:00)
 - Bonus points from exercises
- Simulation, Monday 12:15-14 & Exercises 7x2 h (Thursday 10:15-12:00)
 - Computer simulations and short problems
 - Classroom instruction 5x2 h
- Exams
 - E1: Dec. 08, 2022, Thu 9:15-12:00
 - E2: Will be announced later
 - E3: Will be announced later

Assignments

- 5 assignments, totally **25% of the course grade**
- Simulations with MATLAB simulator and short problems
- Reports are written **in groups of two (or alone)**
- Submit your report to MyCourses no later than assigned deadline, late reports will not be accepted!
- Problems will be given (at least) one week before deadline
- Students are encouraged to discuss with other students but copying solutions from other groups is not allowed!

Simulation Topics

- Getting started with MATLAB
- Buck and boost converters
- Single-phase and three-phase diode rectifiers
- Four-quadrant dc-dc converter
- Three phase voltage-source converter

Course Material

- **Teaching Materials** will be available as pdf form in Mycourse
- **Optional Textbook:** D. Hart, Power Electronics, McGraw-Hill, 2011
- Exercises and their solutions (MyCourses)
- Simulation assignments and a report template (MyCourses)

Grading

Grading, Total Points

Terms	Points
Exam	75
Assignment 1	5
Assignment 2	5
Assignment 3	5
Assignment 4	5
Assignment 5	5
Bonus points	0-5
Total	100

Grading, Course Grade

Grade	Total Points
Fail	0 -<50%
1	50 -<60%
2	60 -<70%
3	70 -<80%
4	80 -<90%
5	90 -100%

- ❖ One question in the exam will be (almost) directly from the exercises.
- ❖ Without simulation assignments, the maximum achievable course grade is 3. Preparing and returning the assignments is highly encouraged!

Estimated Student Workload

	Contact (h)	Individual (h)	Total (h)
Lectures (á 2h)	24	24	48
Exercises (á 2h)	10	10	20
Simulation	10	20	30
Reports		12	12
Preparing for exam		24	24
Taking the exam		3	3
Total	47	90	137

- Weekly individual working is necessary for learning!
 - Reading the textbook
 - Going through weekly exercises
 - Preparing homework
 - Discussing with other students, etc.

**Questions and comments are
most welcome!**