

Power Electronics

ELEC-E8412 Power Electronics, 5 ECTS

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Who Are We?

- **Lectures**

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

- **Exercises**

Mobina Pouresmaeil (mobina.pouresmaeil@aalto.fi)

- **Simulation assignments**

Meysam Saeedian (meysam.saeedian@aalto.fi)

- **Lab assistants**

Dr. Bahman Eskandari (bahman.eskandari@aalto.fi)

Amir Sepehr (amir.sepehr@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 10x2 h, Fridays 8:15 -10:00, TUAS-building, via Zoom
- Exercises 7x2 h (Thursday 10:15-12:00, via Zoom)
 - Bonus points from exercises
- Simulation, Monday 12-14, via Zoom
 - Computer simulations and short problems
 - Classroom instruction 5x2 h
- Hardware lab exercise, (3 h at flexible times, October November)
 - Groups of three students
 - Written report after the lab (group work)
- Exams
 - E1: Dec. 10, 2020, Thu 9:15-12:00
 - E2: Jan. , 2021
 - E3: May, 2021

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

Hardware Lab

- **Topics:**

1. Characteristics of a buck converter
2. Switching characteristics of power MOSFETs and power diodes
3. Characteristics of a boost converter

- **How:**

- Flexible times during the course weeks 3–5
- Groups of three
- Written report after the lab (group work)
- Each student should return the report to MyCourses environment

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)
- Hardware lab instructions

Grading

Grading, Total Points

Terms	Points
Exam	75
Assignment 1	5
Assignment 2	5
Assignment 3	5
Assignment 4	5
Assignment 5	5
Hardware lab work	Accepted
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
Lab work (3h) and report	3	9	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!**