



Aalto University
School of Electrical
Engineering

Syllabus

ELEC-E8402 Control of Electric Drives and Power Converters

Marko Hinkkanen

Spring 2018

Course Description

Course name ELEC-E8402 Control of Electric Drives and Power Converters P

Credits 5 ECTS

Period IV–V

Time 28.2.–23.5.2018 (Wed 8:15–12:00)

Lecture hall Seminaarisali, Open Innovation House, Maarintie 6

Teacher in charge Prof. Marko Hinkkanen (marko.hinkkanen@aalto.fi)

Prerequisites ELEC-E8405 Electric Drives

Teachers

- ▶ Lectures
 - ▶ Marko Hinkkanen
- ▶ Exercises and homework assignments
 - ▶ Eemeli Mölsä
 - ▶ Sina Khamsehchi
 - ▶ Hafiz Asad Ali Awan
 - ▶ Seppo Saarakkala

Course Format and Preliminary Schedule

- ▶ Lectures (11 × 2 h)
- ▶ Problem-solving exercises (5 × 2 h)
- ▶ Instruction sessions for homework assignments (4 × 2 h)
- ▶ Exam 23.5.2018 at 9:00–12:00

Date	Time	
	8:15–10:00	10:15–12:00
28.2.	L1	L2
7.3.	L3	E1
14.3.	L4	S1a
21.3.	L5	E2
28.3.	L6	S1b
4.4.	No teaching	
11.4.	L7	E3
18.4.	L8	S2a
25.4.	L9	E4
2.5.	L10	S2b
9.5.	L11	E5
16.5.	Demo	Demo
23.5.	Exam at 9:00–12:00	

L = lecture

E = problem-solving exercise

S = instruction session

Preliminary Lecture Plan

1. Introduction, induction motor (IM)
2. Scalar-controlled IM drive
3. Vector-controlled IM drive
4. Pulse-width modulation (PWM) and current control
5. Sensorless IM drive, direct torque control (DTC)
6. Grid-connected converters
7. LCL filter, grid distortions, and fault conditions
8. Interior permanent-magnet synchronous motor (IPM)
9. Vector-controlled IPM drive
10. Sensorless IPM drive
11. Guest lecture, recap

Course Materials

Materials available at MyCourses

- ▶ Lecture slides
- ▶ Exercise materials
- ▶ Homework assignments
- ▶ Selected pages of [Control of Voltage-Source Converters and Variable-Speed Drives](#) by L. Harnefors, M. Hinkkanen, O. Wallmark, and A. G. Yepes (2015)

Grading is Based on Two Homework Assignments and an Exam

- ▶ Totally 100 points available
 - ▶ Homework 1: Induction motor drive (15 points)
 - ▶ Instruction sessions: 14.3. and 28.3.2018 at 10:15–12:00
 - ▶ Deadline 4.4.2018
 - ▶ Homework 2: Grid-connected converter (15 points)
 - ▶ Instruction sessions: 18.4. and 2.5.2018 at 10:15–12:00
 - ▶ Deadline 9.5.2018
 - ▶ Exam 23.5.2018 at 9:00-12:00 (70 points)
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- ▶ Assignments are to be completed in groups of two (or alone)
 - ▶ You are encouraged to discuss the assignments in general terms with others
 - ▶ Copying solutions from other groups is not allowed!
 - ▶ MATLAB and Simulink software is needed to complete the assignments!

Grading: Available Points

	Available points
Assignment 1	15
Assignment 2	15
Exam	70
Total	100

- ▶ At least one question in the exam will be (almost) directly from the exercises
- ▶ Homework assignments will also prepare you for the exam

Grading: Course Grade

Grade	Total points
1	50–59
2	60–69
3	70–79
4	80–89
5	90–100

Estimated Student Workload

	Contact (h)	Individual (h)	Total (h)
Lectures (à 2 h)	22	22	44
Exercises (à 2 h)	10	10	20
Assignments (2)	8	24	32
Demo	2	2	4
Preparing for the exam		24	24
Taking the exam		3	3
Total	42	85	127

- ▶ Weekly individual working is necessary for learning!
- ▶ Reading assignments
- ▶ Reviewing lecture slides and exercises
- ▶ Completing homework assignments

After the Course You Will Be Able to...

1. Draw and explain block diagrams of typical vector-controlled and DTC-controlled drive systems
2. Design 3-phase current controllers
3. Select current references for various AC motors
4. Build simulation models for drive systems and power-converter systems
5. Explain the most essential relationships between control of AC motor drives and control of grid converters