



Aalto University
School of Electrical
Engineering

Syllabus

ELEC-E8402 Control of Electric Drives and Power Converters

Marko Hinkkanen

Spring 2021

Course Description

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

Credits 5 ECTS

Period IV–V

Time 3.3.–26.5.2021 (Wed 8:15–12:00)

Distance teaching platform Teams

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

Prerequisites ELEC-E8405 Electric Drives

Teachers

- ▶ Lectures
 - ▶ Marko Hinkkanen
- ▶ Exercises and assignments
 - ▶ Lauri Tiitinen
 - ▶ Ville Pirsto
 - ▶ Mahafugur Rahman
 - ▶ Eemeli Mölsä
 - ▶ Reza Hosseinzadeh

Schedule

- ▶ 11 lectures (8:15–10:00)
- ▶ 5 problem-solving exercises (10:15–12:00)
- ▶ 4 instruction sessions for assignments (10:15–12:00)
- ▶ Exam 26.5.2021 (9:00–12:00)

Date	Lecture	Problem-solving exercise	Classroom instruction for assignments
3.3.2021	1, 2		
10.3.2021	3	1	
17.3.2021	4		1a
24.3.2021	5	2	
31.3.2021	6		1b
7.4.2021	7	3	
Exam week			
21.4.2021	8		2a
28.4.2021	9	4	
5.5.2021	10		2b
12.5.2021	11	5	
19.5.2021	12	Demo	

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 converter
7. LCL filter
8. Grid faults and disturbances
9. Lossless magnetic field, elementary synchronous machine
10. Interior permanent-magnet synchronous motor (IPM) drive
11. Sensorless IPM drive
12. Recap, demo

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 Assignments and Exam

- ▶ Totally 100 points available
- ▶ Assignment 1: Induction motor drive (**15 points**)
 - ▶ Instruction sessions: 17.3. and 31.3. at 10:15–12:00
 - ▶ Deadline 14.4.
- ▶ Assignment 2: Grid-connected converter (**15 points**)
 - ▶ Instruction sessions: 21.4. and 5.5. at 10:15–12:00
 - ▶ Deadline 12.5.
- ▶ Exam 26.5. at 9:00-12:00 (**70 points**)

- ▶ You need MATLAB and Simulink software
- ▶ 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!

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