FEJ3230 Control of Voltage-Source Converters for Grids and Drives 5.0 credits

Kraftelektronisk reglering av omriktare för nätapplikationer och elektriska drivsystem

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FEJ3230 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

PhD students at KTH, PhD students from other universities

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completion of the course the student shall be able to:

· Design robust current controllers for induction motors, permanent-magnet motors, and grid-connected VSCs

· Explain the operation and internal control of MMCs

· Explain similarities and differences between grid-connected VSCs and VSC-fed drives

· Explain the principles and equivalences of direct and indirect field orientation of induction motors

· Explain and simulate sensorless closed-loop induction and permanent-magnet motor control systems

· Explain the basic operation of variable-reluctance type resolvers

Course contents

Methods for design and analysis of control algorithms applied to grid-connected converters and electric drives:

· Quick review of the dc motor and its control; current, speed, field weakening

· Review of theory for linear systems: transfer functions and state-space models

· Three-phase circuits, space-vector theory, and per-unit systems

· Two-level VSCs and their pulsewidth modulation

· Fundamentals of nonlinear systems theory

· Current control of VSCs: fundamental, negative sequence, harmonics; antiwindup

· Synchronization of VSCs: the phase-locked loop

· Active- and reactive-power control of VSCs

· DC-bus-voltage control of VSCs

· Power-synchronization control of MMCs

· Fault ride through of MMCs

· Modeling and internal control of the MMC

· Dynamic model of the induction motor

· VSC-fed drives: similarities and differences to grid-connected VSCs

· Induction motors: principles of direct and indirect field orientation, equivalence

· Induction motors: the current and voltage model for flux estimation

· Induction motors: sensorless control principles

· Field-weakening operation

· Direct torque control

· Permanent-magnet motors: dynamic modeling

· Permanent-magnet motors: current control, speed control and field-weakening operation

· Permanent-magnet motors: low-, medium- and high-speed sensorless control

· Permanent-magnet motors: signal injection, polarity detection, startup, and synchronization

Examination

- EXA1 - Examination, 5.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Since the key parts of the course comprises of the description of a number of control methods, there is no written examination and the examination consists of a project work where the student demonstrates that he/she has obtained the necessary knowledge to be able to implement the methods in practice. The project work consists of a number of simulation tasks in where central parts of the material presented at the lectures will be implemented and evaluated. The results shall then be compiled into a written project report clearly showing how the models have been implemented together with comments on the obtained results. The project work and the associated project report should be carried out individually.

Other requirements for final grade

An approved project work. A project report is deemed approved (by the course examiner) if all tasks have been solved and given a clear account for.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.

- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.