EJ2301 Power Electronics 6.0 credits

Effektelektronik

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

The official course syllabus is valid from the autumn semester 2022 in accordance with the decision from the head of school: J-2022-0543.Decision date: 22/03/2022

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

Knowledge in Electric Power Systems, 6 higher education credits, corresponding to completed course EJ1200.

Language of instruction

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

Intended learning outcomes

After passing the course, the student shall be able to

- describe the function of DC-DC converters, line-commutated converters, switch-mode inverters, and switch-mode power supplies by means of basic equations for inductances and capacitances
- calculate average values, RMS values, ripple and fundamental components of voltages and currents
- calculate instantaneous values, average values, active, reactive, and ripple powers of above-mentioned power converters
- describe different operation modes for above-mentioned power converters and decide whether the converter works in continuous or discontinuous operation mode if applicable
- schematically describe the control of the power converter
- describe the function of power semiconductor devices and how they are controlled and be protected
- describe the function of a DC motor
- dimension a step-down DC-DC converter both electrically and thermally such that given specifications are fulfilled
- apply state-space averaging to control a step-down DC-DC converter

in order to

- learn tools to describe and analyse circuits and control methods for power converters
- be able to describe and apply power semiconductor devices and their control and protection circuits.

To obtain higher grades, the student shall be able to

- analyse the function of DC-DC converters, net commuted converter, switch-mode inverters, and switch-mode power supplies to decide limits for discontinuous operation, evaluate multi-quadrant operation and decide values for circuit element such that given specifications for stationary and transient operation are fulfilled
- analyse complex waveforms for convert quantities by means of Fourier analysis such that harmonics and their impact on the operation can be evaluated
- analyse transient operation of DC-DC converters, line-commutated converters, switch-mode inverters, switch-mode power supplies, and DC motors by means of linear ordinary differential equations
- calculate magnetomotive forces, flux densities, magnetic fluxes, inductances and winding turns of magnetic circuits that are exposed to quantities from power converters

Course contents

Today electricity plays a central role when providing energy to computers, electronics, industrial processes, and trains. They have in common that the electric energy must be converted

and controlled accurately. This course provides a deep understanding of the function of power converters, structure and how they are controlled. The course also covers the basics of modern power semiconductor devices

Examination

- LAB1 - Laboratory Class, 0.5 credits, grading scale: P, F
- PRO1 - Project Work, 1.0 credits, grading scale: P, F
- SEM1 - Peer Assessment, 0.5 credits, grading scale: P, F
- TEN1 - Written Exam, 3.5 credits, grading scale: A, B, C, D, E, FX, F
- XUP1 - Web-based Module, 0.5 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.

Other requirements for final grade

The final mark is based on the written examination but bonus point can be received from LAB1, PRO1, SEM1, and from the exercises.

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.