FEJ3216 Experimental Methods in Power Electronics 8.0 credits

Experimentella metoder inom effektelektroniken

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 FEJ3216 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

PhD students at KTH and 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:

• describe different methods for galvanically isolated voltage measurements

• describe the operation of co-axial shunts

• describe the operation of a Rogowski-coil

• describe the operation of zero-flux Hall-effect-based current sensors

• describe how skew effects measurements of switching transients

• describe the operation of a digital power meter

• describe different potential problems when measuring voltage and current simultaneously

• describe the main idea behind calorimetric measurements

• describe the main idea behind electro-thermal loss measurements

• explain when and why galvanic isolation is necessary

• explain how phase shifts can influence measurement results

• explain how a double-pulse test is performed

• explain how skew can be compensated for

• explain how a measurement setup should be grounded and isolated in order to minimize currents in signal grounds

• explain why the accuracy is likely to be higher for calorimetric loss measurements than for measurements of input and output power

• explain how measurements of forward voltage drops could be performed in order to reduce the effect of self heating

• explain how a short circuit of a bridge leg can be detected and cleared

• calculate approximate values of parasitic currents through signal grounds

• calculate switching losses from double-pulse tests

• calculate converter losses from electro-thermal loss measurements

• calculate converter losses from measured quantities of calorimetric measurements

• calculate stray inductances from voltage and current measurements

Course contents

The following experimental methods are covered:

· Voltage measurement in three-phase systems using compensated voltage dividers and virtual grounding

· Differential high-voltage probes and optically isolated probes for galvanically isolated voltage measurements

· Effects of stray capacitances on currents in signal grounds

· Isolation transformers for reduction of undesired ground currents

· Coaxial shunts and Rogowski coils for high bandwidth current measurements

· Zero-flux Hall-effect-based current sensors

· Digital power meters and their applicability in different measurement setups

· Double-pulse measurements

· Analysis of parasitic elements of the main circuit using current and voltage measurements

· Determination of switching losses from measured waveforms and compensation for measurement skew

· Methods for determination of conduction losses without impact of self heating

· Electro-thermal loss measurements of converters operating at steady state

· Calorimetric loss measurements

· Detection and clearance of short-circuits in bridge legs

Examination

• EXA1 - Examination, 8.0 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.

During the seminars the students should show that they are able to absorb the content of a scientific text and then present it in a professional way for the other students. The students should also show that they are capable of taking part in a scientific discussion on the subject.

The student should prepare a laboratory exercise for the other students. The student should also perform 7 laboratory exercises which have been prepared by fellow students. The written examination is a standard examination with the grades P or F. For the grade P it is required that at least 60% of the maximum number of points are achieved.

Other requirements for final grade

· At least one approved seminar with oral presentation

- An approved laboratory setup for a specified measurement method
- 7 approved laboratory exercises on setups made by fellow students
- An approved written examination.

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.