FEN3213 PCB Design for Power Electronics 8.0 credits

Konstruktion av mönsterkort för effektelektronik

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

Establishment

Course syllabus for FEN3213 valid from Spring 2018

Grading scale

G

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:

- Perform PCB-design using a Computer Aided Design (CAD) software tool.
- Define custom schematic symbols and packages using a CAD software tool.

- Define automatic control of the design rules required for a customized PCB-design.
- Calculate the required clearance and creepage distances for a custom PCB and understand the factors that impact these distances.
- Calculate the required trace width for a customized PCB and understand the factors that impact the required trace width.
- Apply the right type of insulation (basic, supplemental, reinforced, and functional) for different parts of the circuit.
- Apply safety standards for laboratory equipment as well as other regulatory requirements.
- Find component safety information from the regulatory bodies and to use it to comply with safety standards.
- Use a line impedance stabilization network and an oscilloscope to test for conducted emissions.
- Recognize potential EMC problems in a schematic design and take measures to counter these problems at an early stage.
- Design grounding systems for mixed signal circuits, which include a mix of digital, analogue and power electronics such that harmful crosstalk is minimized.
- Protect electrical inputs and outputs against electrostatic discharge (ESD).
- Design a PCB such that it does not cause any problems with production.
- Perform review to other PCB designs increase design quality and reduce debugging time.
- Outline clear schematic diagrams, with the goal to communicate the design effectively and efficiently.
- Choose a suitable type of PCB material / layer buildup for a particular schematic design.

Course contents

- The use of CAD software for PCB design
- Design rule settings, how to use them effectively and efficiently in a PCB program.
- Identify potential challenges in the PCB production.
- Clearance and creepage distances: what mechanisms set the required distance, how to calculate and what do the safety standards prescribe?
- Insulation classes, which class to apply to different parts of the schematic.
- Current carrying capacity and the required trace width for external / internal layers.
- Conducted emissions for EMC standards, requirements and testing for requirements.
- Grounding systems for mixed-signal systems.
- EMC filters
- X and Y capacitors, their use and applicable safety classes.
- EMC filtering, matching filter impedance to the system by using right filter topology.
- Common mode inductors: use and design.
- Environmental conditions: types of classes, when and how to design for (conductive) dust and condensation.

Disposition

Lectures, schematic design + review + feedback, PCB design + review + feedback

Course literature

Presentation slides, handouts.

Equipment

None.

Examination

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.

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

The course content is focussed on schematics and PCB design for power electronics. The project work is supervised by an external senior expert consultant from industry in order to make sure that a professional level of competence is achieved. The written examination focuses on the theoretical basis of electromagnetic compatibility and safety standards. Experience has shown that EMC problems can cause major delays in projects and the importance of safety standards should be self-evident.

The students are not only required to acquire the theoretical knowledge for PCB-design, but also master a new software package for PCB design as well as passing the PCB design project within the course. An average workload of 8 HP per course participant is expected.

Other requirements for final grade

The examination consists of an approved project work and an approved written examination.

A completed schematic design and a completed PCB design are needed for passing the project work. Both shall fulfill the required safety standards, as well as having the right measures in place for fulfilling EMC standards. The written exam focuses on the fundamentals of EMC and safety standards.

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.