FEJ3280 Power Electronics for Transmission Systems 7.5 credits

Effektelektronik för transmissionstillämpningar

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

Establishment

Course syllabus for FEJ3280 valid from Spring 2018

Grading scale

G

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 how power electronics can be used for improved utilization of the power grid, stabilization and power loss reduction.
  - Describe typical durations of different processes present in power grids.
  - Describe the orders of magnitude of the electrical quantities commonly present in power grids.
  - Describe the properties of cables and overhead lines in terms of their surge impedance load (SIL), loadability and their impact on the power system.
- Explain the main design limitations of transformers, inductors, and capacitors
- Calculate roughly the size and losses of passive components and transformers using physical scaling rules
- Describe the main characteristics of Thyristors, IGBTs, IGCTs, Power Diodes, and Emerging SiC devices
- Describe the main characteristics of circuit breakers, disconnectors, current transformers, voltage transformers, and surge arresters
- Explain how the reliability of a converter can be increased by means of redundancy
- Explain why capacitive shunt compensation usually must be controlled
- Explain the operation principles of controlled series- and shunt compensation
- Describe the circuit layout of two- and three-level voltage source converters, modular multilevel converters, and H-connected cascaded full-bridge converters.
- explain in simple terms the operating principle of two-level converters and modular multilevel converters with full-bridges and half-bridges
- Calculate the required ratings of a static VAr compensator from a given specification of reactive power generation/consumption. This includes the inductor, the thyristors, the capacitors, and the control angles for various operation points.
- Calculate the modulation index and phase angle for a VSC HVDC converter for a given value of produced reactive power, transferred active power, dc-side voltage and phase inductance
- use analysis tools like Simulink and real-time simulation for simple studies of power electronics in transmission system applications
- describe a typical control structure for a grid-connected voltage-source converter
- describe the main characteristics of phase-shifting transformers
- describe the main characteristics of TSSC and TCSC

Course contents

- Power system basics – active and reactive power
- Electric power transmission using overhead lines and cables
- Properties of power semiconductors and passive components
- Circuit topologies for FACTS and HVDC converters
- Control methods for various control task such as voltage control and power-flow control
- Pulse width modulation methods and harmonics
- Analysis tools for power electronics in transmission system applications
- Series and shunt compensation of AC systems
- HVDC Transmission and active power transmission
- Railway feeding applications
- Redundancy and fault tolerance

Disposition

Lectures, laboratory project, written examination

Course literature

Compendium and handouts

Equipment

Laboratory equipment is provided by the Dept. of Electric Power and Energy Systems

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 project work is a task where the content of the course is used. The result of the project work is evaluated in a laboratory exercise. The written examination is a standard examination with the grades P or F.

Other requirements for final grade

- An approved laboratory project where the design is evaluated
- 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.