Module Description

Power Electronics Systems

General Information

Number of ECTS Credits

3

Abbreviation

TSM_PowElSys

Version

19.03.2014

Responsible of module

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Language

	Lausanne	Bern	Zürich
Instruction	☐ E ☐ F	☐ D ☒ E ☐ F	☐ D ☐ E
Documentation	☐ E ☐ F	☐ D ☒ E ☐ F	☐ D ☐ E
Examination	☐ E ☐ F	☐ D ☒ E ☐ F	☐ D ☐ E

Module category

☐ Fundamental theoretical principles
☒ Technical/scientific specialization module
☐ Context module

Lessons

☒ 2 lecture periods and 1 tutorial period per week
☐ 2 lecture periods per week

Brief course description of module objectives and content

Building upon the students' fundamental knowledge in power electronics, this module covers current topics in the field of power electronics in greater depth. In the first part, the focus is on modern switched mode power conversion topologies, small signal modelling, control methods and the magnetic components. The second part looks into topologies, modulation schemes and control techniques for medium and high-power converters. One application discussed in greater depth is their application in power grids.

Aims, content, methods

Learning objectives and acquired competencies

The students are taught modelling methods, structure and control of power electronics circuits based on selected practical and realistic examples.

Contents of module with emphasis on teaching content

Switched mode power supplies: 7x3h

- Overview over the most common topologies
- Soft switching in switched mode power converters
- Resonant converter
- Small signal modelling of switched mode power converters
- Control of switched mode power converters
- Magnetic components
- Integrated magnetics

Medium and high-power converters: 7×3h

- Three-phase inverters (topologies, modulation techniques, harmonics)
- Multi-level inverters (topologies, modulation techniques, harmonics)
- Rectifiers and transformers for higher pulse-numbers
- Control methods for converters
- Special features of high-power converters like semiconductors, protection and cooling
- FACTS (Flexible AC Transmission Systems): applications of high-power converters in energy transmission like interties, SVC (Static-Var-Compensation), DVR (Dynamic Voltage Restorer), HVDC (High Voltage DC Transmission)

Teaching and learning methods

- Lecture, interactive instruction and discussion
- Embedded exercises (with Matlab, Simulink and PLECS)

Prerequisites, previous knowledge, entrance competencies

To attend the module, a good fundamental knowledge in electrical engineering is essential. In addition, a sound basis in power electronics and control technique is needed.

- **Power electronics:** Characteristics, driving and application of power diodes, thyristors, MOS- field effect transistors, IGBT, as well as GTO-thyristors, are known.
- The **basic power electronics circuits**, with and without galvanic isolation, are known and understood. E.g. boost and buck converter, flyback and forward converter, one- and three-phase self-commutated bridges with semiconductors having turn-off capability, line-commutated rectifiers.
- **System description** with transfer function can be derived and represented in a Bode diagram. Additionally, a basic knowledge of descriptions in state space is useful.
  PI- controller design with help of the Bode diagram (or other methods) can be carried out.

Literature

Documents will be made available in electronic form

Assessment

Certification requirements for final examinations (conditions for attestation)

Two accepted exercises.

Written module examination

Duration of exam:	120 minutes
Permissible aids:	- Course documents and personal notes - Personal calculator (no PC)