Module Description, available in: EN

Power Electronics Systems

General Information

Number of ECTS Credits

3

Module code

TSM_PowElSys

Valid for academic year

2024-25

Last modification

2021-02-10

Coordinator of the module

Adrian Omlin (HSLU, adrian.omlin@hslu.ch)

Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%		
Documentation					**X** E 100%		
Examination					**X** E 100%		

Module Category

TSM Technical scientific module

Profile Recommendations

This module is recommended for the following profiles:

	Zurich
Profile	ElE, EnEn

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

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.

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 competencies to be acquired

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

Module content with weighting of different components

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)

Literature

Documents will be made available in electronic form

Assessment

Certification requirements

Module uses certification requirements

Certification requirements for final examinations (conditions for attestation)

Two accepted exercises.

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

Personal calculator (no PC, no Mobile)

Other permissible aids

A summary for the part power supplies (S. Mariéthoz)

Course documents and personal notes for the part high-power converters (A. Omlin)

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

No aids permitted