

Module Description

Electrical Energy Systems

General Information

Number of ECTS Credits				
3				
Abbreviation				
TSM_EIEnSys				
Version				
19.02.2015				
Responsible of module				
Vinzenz Härri, HSLU				
Language				
	Lausanne	Bern	Zürich	
Instruction		DD ME DF	DD DE	
Documentation	DE DF	DD NE DF	DD DE	
Examination	DE DF	DD NE DF	DD DE	
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

In this module, students will increase their knowledge in selected areas of energy production, energy distribution and energy utilization in the systemic environment. Emphasis is placed on modern topics of electrical energy, such as grid quality, energy storages, smart-grids or the European super-grid.

Aims, content, methods

Learning objectives and acquired competencies

- 1.1 know the main challenges of today's modern grids
- 1.2 know the main elements of an electrical grid and the differences of transmission components
- 1.3 know the DC transmission technology
- 2.1 know the worldwide importance of primary energies as regards the electricity market;
- 2.2 can explain the market pressure by suppliers of fossil primary energy;
- 2.3 know obstacles for the market entrance of renewable energies;
- 3.1 know the significance and the possibilities of energy storages and are able to name at least two pro and two contras of each storage type in specific applications;
- 3.2 know fundamental points in the integration of accumulators and supercapacitors;
- 3.3 can describe the significance of smart-grids and there interaction with energy storages
- 4.1 know who frequency stability can be reached and what errors can arise in the network and know how to protect the equipment;
- 4.2 learn the basic principles of the management and regulation of electrical grids;
- 4.3 learn to assess the dynamic stability of networks and know quality attributes of grids;



Contents of	ontents of module with emphasis on teaching content			
Course	Designation	Week		
1	Introduction, Energy and Market Topics	1-2		
	Energy policy, challenges modern grids			
	The open electricity market is setting up the economic conditions			
2	Smart-grids, energy storage technologies and peak power handling			
	Wanted! Energy storage technologies, not only for the electrical mobility!			
	What about the integration of mobile, central and decentral energy storages?			
	Smart-grids: a change of paradigmn and change for optimazations, but what for?			
	The practical aspects of smart-grids: Case Study			
3	Special Chapters on T&D	7-9		
	Power Quality – A constant and sinusoidal voltage is not at random			
	Cables and overhead lines in modern grids:			
	Where to use?			
	HVAC and HVDC Transmission in future grids			
4	Modern Grids	10-14		
	Synchronous machines are the heart of the grid			
	Stability of frequency and fault detection			
	Interconnected grid operation: every grid element fulfils its task.			
	Dynamic interaction and stability of large grids: regulators, dynamic behaviour of SM			
	Dynamic interaction and stability of large grids:			
	static & dynamic stability, active & passive damping			

Teaching and learning methods

- Ex cathedra teaching
- 9 practical exercises
- Presentation and discussion of case studies
- Prerequisites, previous knowledge, entrance competencies

The students

- know the basics of an electrical circuit,
- have basic knowledge of energy generation, conversion and distribution at Bachelor degree level, and
- know the main electrical components such as motors, transformers, and converters at Bachelor degree level.

Literature

Attestation

Certification requirements for final examinations (conditions for attestation)

Certification requirements: Al least four out of nine exercises, at least one of each of the four parts must be worked on, handed in, and become accepted.

Written module examination

Duration of exam

Permissible aids

120 minutes

Only calculator and 2 A4 double-sided pages summary are permitted