EE-473

Principles of power systems

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Cursus	Sem.	Type
Energy Science and Technology	MA2, MA4	Opt.
Energy minor	E	Opt.

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	Written
Workload	60h
Weeks	14
Hours	**2 weekly**
Courses	2 weekly
Number of positions	

Summary

The course provides the fundamental concepts to model power systems and understand their operation.

Content

Introduction to power systems

- Structure of power systems
- Classification as a function of the rated voltage

Elements of transmission lines for the transportation of electricity

- Transmission lines modeling in the frequency domain
- Expressions of electrical power flows in transmission lines
- Numerical simulation of transmission lines

Fundamentals of electrical machines

- Magnetic circuits and operation of transformers
- Transformers equivalent circuits and parameters derivation
- Rotating induction machines: operation and equivalent circuit
- Rotating synchronous machines: operation and equivalent circuit

The load flow problem

- From the physical network to the admittance matrix (nodal analysis in steady state conditions)
- Problem formulation in cartesian and polar coordinates
- Numerical solution of the load flow problem
- Applications of the load flow problem to real cases

Frequency regulation in power systems

- Power balance and frequency in power systems
- Primary frequency control
- Secondary frequency control
- Dynamic simulation of power systems

Study of unbalanced three-phase power systems

- Symmetrical components
- Decomposition of a three phase system via the symmetrical components

- Conservation of power in the phase and symmetrical components domains
- Applications of symmetrical components

Keywords

Power systems, modeling, transmission lines, electrical machines, load flow, frequency control, unbalanced power systems.

Learning Prerequisites

Required courses

Fundamentals of electrical circuits and systems

Important concepts to start the course

Modeling of electrical circuits and steady state signals. Numerical analysis of non-linear problems.

Learning Outcomes

By the end of the course, the student must be able to:

- Model Power systems component
- Conduct Simulations of power systems in steady state and dynamic conditions

Teaching methods

Ex-cattedra, exercises and numerical simulations using dedicated software environments.

Assessment methods

Written exam at the end of the semester.

Resources

Notes/Handbook

Notes and exercises are made avaialble on Moodle during the course.

Moodle Link

- https://go.epfl.ch/EE-473