

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
<b>Hours</b>	<b>2 weekly</b>
Lecture	2 weekly
<b>Number of positions</b>	

**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

**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 available on Moodle during the course.

#### **Moodle Link**

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