Electrical Energy for Sustainable Development

In brief

Course langage: French

Presentation

Learning objectives

- Analyze single and three-phase electrical circuits, balanced and unbalanced.
- Understand the operation and characteristic mechanisms of power electronics components in switching.
- Acquire the basics necessary to understand electrical and electromechanical energy conversion systems.
- Acquire general knowledge on the operation and use of electromechanical converters (rotating machines).
- To know the basic properties of the three types of electrical machines (DC, AC and stepper).
- To enable students to understand the development, structure and different functions of sensors and actuators of electrical energy conversion systems as well as their electronic power supply.
- To enable students to understand the development, structure and different functions of electrical and electromechanical energy conversion systems.

Description of the programme

Electrical Circuits (2 hrs)
Electrical power distribution networks, equivalent circuits, power factor, balanced and unbalanced systems, definitions and calculation and measurement of power.

Static conversion of electrical energy (10 hrs)
- Single-phase transformer: equivalent electrical diagram and determination of elements, transformer on load, energy balance, power factor measurement.
- Power electronics: principles of power electronics, different types of electrical energy conversion, power electronics components, basic AC-DC converters, DC-DC converters (Buck and Boost type), applications of power electronics in industrial and human activities.

Electromechanical Conversion (10 hrs)
- Electrical, magnetic and mechanical energy, power and torque calculation.

- Direct current machine (DCM): different types of excitation, operating equations, characteristics, energy balance, variable speed drive, universal motor.
- Asynchronous machine (MAS): creation of the rotating field, technological aspects, operating principle, single-phase equivalent diagram, determination of the elements of the equivalent diagram, characteristics of the three-phase asynchronous motor, torque, energy balance, variable frequency drive.
- Synchronous machine (SM): constitution, technological aspects, operating principle, description of synchronous machines, calculation of power and torque, variable frequency supply.
- Stepper motor: operating principle, different types of stepper motors and their control modes, static and dynamic behavior, fields of use.

Simulation of a DC machine fed by a DC/DC Buck converter (step-down chopper) using Matlab-SimuLink .

Generic central skills and knowledge targeted in the discipline

- Ability to conduct "systems" thinking.
- Understand the operation of the major components of an electrical network.
- Ability to identify the elements necessary to understand electrical power conversion systems.
- Ability to understand the basic principles and purpose of power electronics, study and analysis of DC/DC Buck, Boost and single phase controlled and uncontrolled AC/DC converters.
- Understand the operation of the main elements of an electric motorization (example: electric traction).
- Ability to understand all the scientific and technical dimensions of all the elements of an electrical and electromechanical energy conversion chain from a specification.

How knowledge is tested

2 hour evaluation

Bibliography

- Course and lab handouts
- Copy of the course slides
- Books available at the ECM library

Total des heures		**30h**
CM	Master class	22h
TD	Directed work	4h
TP	Practical work	4h

Useful info

Name responsible for EU

Lead Instructor

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