2SC5610 – Introduction to energy production

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Department: DÉPARTEMENT SYSTÈMES D'ÉNERGIE ÉLECTRIQUE
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 60
On-site hours (HPE): 34,50

Description
To reduce energy consumption and polluting emissions it's necessary to use energy systems that includes sources whose efficiency and characteristics are complementary. This is true for electricity generation systems, where the growth of intermittent renewable generation requires more flexibility from conventional means of production, and also from the transport sector, where the electric and thermal powertrains complement each other advantageously.
These multi-energy systems require advanced control modes to take advantage of the complementarity of energy sources, and satisfy user needs and economic, technical and environmental constraints.

Quarter number
ST5

Prerequisites (in terms of CS courses)
Transport Phenomena, Electric energy

Syllabus

1. Thermal energy conversion
Turbomachines (turbojets, turboalternators)
Internal combustion engines
Introduction to the physics of nuclear reactors

2. Electrical energy conversion
Structure of AC machines, motor / generator operation
Electronic converters.
Principles for speed variation of machines (machine system and converters)

Class components (lecture, labs, etc.)

Thermal energy conversion : CC1, CC2, CC3, CC4 + T1, T2

Electrical energy conversion : CC5, CC6, CC7, CC8 , CC9,+ T3, T4

CC : Core Curriculum
T : Tutorial

Grading

Exam at the end of the course for 1 hour and a half.

Course support, bibliography

lecture notes

Resources

Teaching staff: Amir Arzandé, Maya Hage Hassan, Antoine Renaud, Pierre Duquesne (Centrale Lyon), Pascal Yvon (CEA)
Size of tutorial classes (default 35 students): 25
Tutorials in classical auditorium and computer rooms

Learning outcomes covered on the course

At the end of this course students will be able to
Understand the basics of energy conversion systems in mechanics and electrical.
Understand different ways of converting thermal energy into mechanical one (internal combustion engine, turbomachine, nuclear core).
Identify the strengths and constraints of these different modes of energy production as well as to propose first elements of pre-sizing.
Propose a fast modeling of synchronous and asynchronous machines and converters and also to identify some machine / converter systems for hybridization applications, with regards to the electrical portion of the course.

Description of the skills acquired at the end of the course

Examine problems in their entirety and beyond their immediate parameters. Identify, formulate and analyse the scientific, economic and human dimensions of a problem

Develop and use appropriate models, choosing the correct modelling scale and simplifying assumptions when addressing a problem
Apply problem-solving through approximation, simulation and experimentation. / Solve problems using approximation, simulation and experimentation
Design, detail and corroborate a whole or part of a complex system
Create knowledge within a scientific paradigm
Master the skillset of a core profession within the engineering sciences (at junior level)
Be proactive and involved, take initiatives
Act ethically, with integrity and respect for others
Demonstrate rigour and critical thinking in approaching problems from all angles, be they scientific, social or economic