

Energy conversion

Subject Information	
Code	UE5 S2
Credits (ECTS)	7
Semester	1 (mid-September – mid-January)
Time Allocation (Lec. / Prac. / Lab/ Project)	55 h / 35 h / 0 / 0
Lecturers	Pr Frédéric MARIAS, Pr Mathieu MORY, Dr Didier Haillot, Dr Tarik Kousksou
Pre-requisites	
Assessment	Final exam

Lec. : Lectures

Prac. : Practical works ("small classes")

Lab. : Laboratories

Subject Description	
Introduction	The purpose of this course is to study the different ways of converting energy resources into useful energy services.
Learning outcomes	<p>After this course the students should be able to:</p> <ul style="list-style-type: none"> - describe the major processes for producing electricity; - give the typical sizes of the technologies; - explain the influence major parameters that influence the efficiency of the power plants;
Content	<ol style="list-style-type: none"> 1. Nuclear power plants and coal power plants (15 h) <i>Content</i> Principle of nuclear fission, different types of reactors, efficiency of nuclear power plants. Cycles for energy conversion in coal power plants, technologies for coal combustion and pollution control. 2. Biomass conversion and biofuels (10 h F. Marias) <i>Content</i> Characterization of the different types of biomass, specific issues linked to the biomass use as an energy source. Types of energy services that can be satisfied by biomass, overview of the different processes that can be used for biomass conversion. Economic and environmental aspects. <i>Objectives</i> Understand the problematics linked with the use of biomass as an energy source. Be able to understand the different processes used for biomass conversion, and the types of energy services that they satisfy. 3. Mechanical energy conversion (2 h M. Mory) <i>Content</i> Forces, energy and power

Objectives

Introduce that the scaling of an optimized mechanical system is the compromise between force and velocity (or head and flow rate...)

4. Principles of the hydropower (8 h M. Mory)

Content

Classification of hydropower plants according to the available water and head.

Losses and the optimized scaling of a power plant, turbine choice.

Medium and high head power plants.

Low head power plants, including tidal power plants.

Energy storage using power plants

Objectives

Know the principles of scaling of a hydropower system and be aware of the classification of hydropower system in relation to turbines types.

Be aware of available operating systems

5. Wind energy and marine current energy (8 h M. Mory)

Content

The Betz formula.

Wind energy turbines, capacity factor, onshore/offshore wind turbines

Marine current energy turbines

Objectives

Know the principles of scaling of a wind and current marine turbine

Be aware of available operating systems

6. Other Marine energies (17 h M. Mory)

Content

Scaling of an osmotic power energy system.

Scaling of an Ocean thermal energy system.

Wave energy: available resource, Wave energy converters (Oscillating water column systems, overtopping systems, point absorbers), control operation.

Objectives

Know the available resource of marine energies, the different systems of marine energy conversion.

Be aware of available operating systems

7. Geothermal energy (10 h M. Mory)

Content

Description of the different conversion technologies from geothermal resources.

Efficiency of power production from geothermal resources, economic aspects and examples.

Introduction to energy aspects of urban systems, integration of heat pumps. Energy savings and CO₂ reduction.

Objectives

Understand the thermodynamic principles used for electricity production from geothermal resources

Know the fields of application of the different technologies, their advantages and their drawbacks

Know about the important energy aspects in urban systems

8. Conversion of sun energy (10 h D. Hailot)

Solar heat, Solar thermal plants and Photovoltaics

Content

Solar energy fundamentals, concentrated solar power, solar thermal power plants, parabolic trough, central receiver system, solar field investment cost and levelised electricity cost.

Objectives

Know about the different technologies of solar thermal plants and their economics.

9. Fuel cells and others (10 h T. Kouksou)

Literature