Renewable energy technology

Lecturers
Julien BLONDEAU (Coordinator) and Johan GYSELINCK

Course mnemonic
MECA-H414

ECTS credits
4 credits

Language(s) of instruction
English

Course period
First term

Campuses
Solbosch and Plaine

Course content

This course provides a detailed description of selected technologies for the production of renewable energy: solar PV power, wind power, biomass combustion and gasification, and hydropower.

The following technical aspects will be covered during the sessions:

- Solar PV power: resources, cell and module technologies, PV inverters, PV system design
- Wind power: resources, aerodynamics, Betz model, electrical configurations
- Biomass: context, sustainability, properties, combustion, gasification.
- Hydropower: context, basic hydrology, plant description, types of turbines (Pelton, Francis, Kaplan).

The students will also work on the design or the analysis of specific systems in several group projects. One of them will be based on the integration of various renewable technologies to fulfil a given energy demand.

Objectives (and/or specific learning outcomes)

At the end of this course, the students will be able to:

- Provide a detailed technical description of the renewable energy technologies that were covered;
- Explain the main elements to be taken into account for the design of such systems, and apply them to simple cases;
- Carry out a pre-feasibility study for the design of a Hybrid Renewable Energy System (HRES) able to fulfill a given energy demand.

Teaching method and learning activities

- Lectures
- Exercise sessions
- Group work
- Visit

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of integrated structural design methods in the framework of a global design strategy
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Conceive, plan and execute a research project, based on an analysis of its objectives, existing knowledge and the relevant literature, with attention to innovation and valorization in industry and society
- Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
- Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- Collaborate in a (multidisciplinary) team
- Work in an industrial environment with attention to safety, quality assurance, communication and reporting
- Develop, plan, execute and manage engineering projects at the level of a starting professional
- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- A critical attitude towards one's own results and those of others
- Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects
- The flexibility and adaptability to work in an international and/or intercultural context
- An attitude of life-long learning as needed for the future development of his/her career

- Has a broad scientific knowledge, understanding and skills to be able to design, produce and maintain complex mechanical, electrical and/or energy systems with a focus on products, systems and services.
- Has an in depth scientific knowledge, understanding and skills in at least one of the subfields needed to design, produce, apply and maintain complex mechanical, electrical and/or energy systems;
- Has an in-depth understanding of safety standards and rules with respect to mechanical, electrical and energy systems.

References, bibliography and recommended reading

General Overview

- Sustainable energy – without the hot air – David MacKay. 380 Pages, UIT Cambridge Ltd, 2009. Free download - http://www.withouthotair.com/ - ISBN: 978-0954452933
- Renewable Energy : Power for a Sustainable Future - Godfrey BOYLE; 452 pages, Oxford University Press second edition, 2004, ISBN 0-19-926178-4
- Renewable energy in power systems - Leon FRERIS and David INFIELD; 284 pages, Wiley edition, 2008. ISBN 978-0-470-01749-4

Wind, Photovoltaic and Grid Integration

- Handbook of Energy Efficiency and Renewable Energy, 1560 pages, CRC Press, 1 edition (May 7, 2007), ISBN-10: 0849317304, ISBN-13: 978-0849317309 (chapter 22 on wind energy systems, chapter 23 on photovoltaic systems)
- WIND ENERGY - THE FACTS, March 2009, 488 pages, http://www.wind-energy-the-facts.org/, ISBN: 978184407710

Biomass

- Handbook of Energy Efficiency and Renewable Energy, 1560 pages, CRC Press, 1 edition (May 7, 2007), ISBN-10: 0849317304, ISBN-13: 978-0849317309

Course notes

Université virtuelle

Other information

Place(s) of teaching

Plaine and Solbosch

Contact(s)

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Johan Gyselinck: johan.gyselinck@ulb.be

Evaluation method(s)

written examination, Practice exam and Group work

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IREM | Master of science in Electromechanical Engineering | finalité Professional/unit 2