EIE N10 – Wind Power Systems

Course Info & Goals

Overview

Credits: 7,5.

Grading scale: TH. **Cycle:** A (Second Cycle)

Main field: Technology.

Language of instruction: The course might be given in English.

Optional for: E4, E4em, F4, F4es, M4, W4es.

Course coordinator: Jörgen Svensson, jorgen.svensson@iea.lth.se, Industrial Electrical Engineering and Automation.

Recommended prerequisits: ESS060 Electrical Engineering or MIE012 Electrical Engineering, basic course, or ETE115 Electromagnetics and electronics.

Assessment: Project and assignments, laboratory exercise, simulation exercise and micro-siting exercise, and a written exam. The written exam (5h) is problem solving mixed with theory and questions.

Home page: www.iea.lth.se/wps

Aim

The course is aiming at giving the student basic knowledge in wind power and its use in society. It also aims at identifying and explaining wind power technology, -systems and integration to the power system in an engineering context. The course has great relevance to the sustainable development of the energy system where wind power now is the most expansive renewable energy source with a global yearly rate of expansion of about 20%.

The need for electric energy is constantly growing at the same time as the demands for sustainable electric power production is increasing. The development of environmentally friendly alternatives is increasing gradually because of the raised national goals on renewable electric power production. In Sweden, the electric certificate system is the driving force for renewable electric power production. With an increasing renewable energy, the demands on the power system are raised, due to the reduced control margins. To keep the high standard of reliability, the demands on the wind power systems will also increase.

In the course, the situation and possibilities for wind power to contribute to energy support in Sweden and globally are penetrated. We study among other things the wind as a resource of energy, the production and construction of wind power plants, and related environmental issues.

Knowledge and understanding

For a passing grade the student must

- understand the importance of the wind conditions and the surroundings to judge the site for wind power plants (WPPs)
- understand the importance of reciprocal placement of wind turbines in a WPP
- be able to describe a WPP on both system- and component- level
- be able to describe various wind turbine constructions with benefits and drawbacks
- be able to account for various control methods and limitations of WPPs
- understand the technical demands (grid codes) that apply for connection to the grid
- understand the meaning of small and large scale wind turbines and its impact on the power system
- be able to describe the environmental impact of wind power plants
- be able to describe the main work phases in project development, construction and operation & maintenance

Skills and abilities

For a passing grade the student must be able to

- inform about and describe wind power systems in an objective way
- carry out dimensioning calculations for wind power plants
- formulate a mathematical model of a wind turbine from the information on its components and how they interact
- analyze and estimate the yearly electricity production of a wind power plant
- relate plant site, wind turbine placing, rotor diameter, generator capacity and efficiency for the selection of design and optimization of electricity production
- relate the choice of design and wind turbine construction to judge the robustness and availability
- make an economical analysis of a wind power plant.

Judgment and approach

For a passing grade the student must

- show understanding of the possibilities and limitations of wind power and its role in society
- be able to judge objectively for or against wind power as well locally as nationally and globally

Contents

- Historical overview of the development of the wind power and its geographical expansion
- Wind potential and its physical background. Impact of terrain at the selection of plant place. Calculation of energy contents and production.
- Technology and systems for wind power plants. Function and characteristics for various designs. Control and operation.
- Large and small scale expansion. Example of a large scale offshore wind power plant.
- Design and dimensioning for optimization of production, availability, and cost.
- Integration of the wind power system to the power grid. Demands for connection and ancillary services.

- The influence of wind power on the electricity market.
- Modeling, simulation and analysis of wind power systems.
- Work stages in projecting, construction and operation & maintenance.

Literature

James F. Manwell, Jon G. McGowan, Anthony L. Rogers: Wind Energy Explained: Theory, Design and Application, 2009, 2nd International Edition,
ISBN: 9780470015001

Additional information

www.windpower.org

Here are also links to other web sites on wind turbines and wind power systems