Course syllabus

Vindkraftsystem
Wind Power Systems

EIEN10, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED E
Date of Decision: 2023-04-11

General Information

Elective for: E4-em, F4, F4-es, M4-en, W5-es, MHET2
Language of instruction: The course will be given in English on demand

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 20%.

The need for electrical energy is constantly growing at the same time as the requirements for environmentally friendly electricity production are increasing. The expansion of environmentally friendly alternatives is gradually increasing as a result of global and national goals for renewables. In Sweden, the electricity certificate system exists as a driving force for the expansion of renewables. Wind power is expected to gradually take an increasing share as the existing nuclear power decreases and probably is phased out before 2040. With larger share of renewable electricity, the electric power system will need more flexibility as a result of reduced regulatory margins. In order to maintain the high operational reliability of the electricity supply, the requirements for wind power systems will also increase. Especially for newly established and coming large-scale wind power plants both onshore and offshore.

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 the plants, and environmental issues.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- understand the importance of the wind and the surroundings to judge the site for wind power plants
- be able to describe various wind turbine constructions with assets and drawbacks
- be able to describe a wind power plant on both component and system level
- be able to account for various control methods and limitations of wind power plants
- understand the importance of reciprocal placement of wind turbines in a plant
- understand the technical demands (grid codes) that apply for connection to the grid
- understand the meaning of small and large scale dimensioning and the impact on the power system
- be able to describe the most important moments of projecting, design and operation & maintenance
- be able to describe the environmental impact of wind power plants.

Competences and skills
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
- formulate a mathematical model of a wind turbine from the information on its components and how they interact
- analyze and estimate the yearly energy 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 energy 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.

Judgement 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 opimization 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.
- Modelling, simulation and analysis of wind power systems.
- Work stages in projecting, construction and operation & maintenance.

Assignments, project and laboration.

Study visit at a wind power plant.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: To pass the course, one laboration with preparations, four assignments and a project task together with a written exam are necessary. The written exam is problem solving mixed with theory questions.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0111. **Name:** Wind Power Systems.
Credits: 7,5. **Grading scale:** TH.
Code: 0211. **Name:** Laborations and Project.
Credits: 0. **Grading scale:** UG.

Admission

Assumed prior knowledge: ESSF15 Electrical Engineering or MIE012, EIEF35 Electrical Engineering, basic course, or ETE115, EITF90 Electromagnetics and electronics.
The number of participants is limited to: No

Reading list

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

Contact and other information

Course coordinator: Dr Jörgen Svensson, jorgen.svensson@iea.lth.se
Course homepage: https://www.lth.se/iea/utbildning/valfria-kurser-i-lund/vindkraftsystem/