Advanced Wind Energy
Andreas Günther

Design of Wind Turbines

Modulbeschreibung

PUBLIKATION DER BILDUNGSALLIANZ MINT.ONLINE:
UNIVERSITÄT OLDENBURG, UNIVERSITÄT KASSEL, UNIVERSITÄT STUTTGART, FERNUNIVERSITÄT IN HAGEN, FRAUNHOFER-GESELLSCHAFT, DLR-INSTITUT FÜR VERNETZTE ENERGIESYSTEME (EHEMALS NEXT ENERGY)

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Das diesem Bericht zugrundeliegende Vorhaben wurde mit Mitteln des Bundesministeriums für Bildung, und Forschung unter dem Förderkennzeichen 16OH12044 gefördert. Die Verantwortung für den Inhalt dieser Veröffentlichung liegt beim Autor/bei der Autorin.

School of Mathematics and Science, Institute of Physics,

Module: Design & Simulation of Wind Turbines

This module is associated to the following degrees
Master > Renewable Energy Online> Specialisation Module

Abstract:

This module consists of a theoretical part and a practical part:

In the **theoretical part**, the students will learn the fundamentals of wind power generation and utilization. The course starts with the explanation of the physics behind the generation of the wind, its occurrence and how wind measurements are carried out. Concepts about the energy and power available in the wind, as well as the types of wind energy converters will be described. The aeromechanical energy conversion is explained thoroughly, including the basic blade aerodynamic design. The main components of the wind turbine are also characterized, along with the main drive train, generator concepts and power control strategies. Insights on the mechanical design of the wind turbine components will be given, based on the generation and occurrence of loads. Environmental effects, political and social aspects of wind energy utilisation will be discussed as well.

In the **practical part** calculation exercises will be given to complement the knowledge of the theoretical part. Additionally, students will get insights on how wind farm planning is done in the industry. They will perform tasks related with the assessment of the wind resource, energy yield, wind farm efficiency, shadow casting and noise emission of a wind farm. In a self-contained work they will select types of wind turbines and establish a wind farm layout for a given site. They will also optimize the wind farm design, in regard of energy yield and environmental impacts. Tasks to learn about basic economic calculations will be also provided.

Duration:	1 semester	Teaching form:	Theoretical – practical seminar. e-learning.
Cycle:	Winter semester	Language:	English
Type of module:	Elective	Attainable credit points:	6 ECTS
Level:	MM (master module)	Workload:	180 hours
Pre-requisites:	Wind Energy Fundamentals	Max. No. of students:	30 students

Lecturer(s):	Mentor(s):
Designer(s) of the module: Martin Kühn, Luis Vera-Tudela	Examiner(s):

Objective of the module /learning outcomes:

After successful completion of the module students should be able to:

- critically contribute to the discourse on wind energy design and simulation
- explain and evaluate technical details of a wind energy converter
- decide and to defend a design of a wind energy converter
- recommend on technical details of a wind energy converter
- transfer their knowledge to more complex topics such as simulation and measurements of dynamic loads
- assess different aspects of wind energy farms by modelling, comparison, explanation of wind energy potential, wind energy farm's output, power curves, wind energy project development

Content of the module:

- Calculation of the aerodynamics of wind turbines using the blade element momentum theory,
- Specific design situations for wind turbines,
- Estimation of the influence of dynamics of a wind turbine, especially in the context of fatigue loads,
- Aeroelastic simulation of wind turbines
- Annual Energy Production (AEP)
- Design of a commercial (equivalent) wind turbine

Forms of learning:

The learning process will be predominantly based on reading material (self-learning). Practical exercises are designed to complement the knowledge of each chapter of the module.

Of course, the aim of the developers and lecturers of this modules is to have constant contact with the students, in order to address any type of difficulties. This is the reason why online discussion Webinars and forums are going to be available for active discussions. Furthermore, the student`s can contact the staff directly, in order to have personal guidance.

Helpful previous knowledge:

Web link:

Associated module(s)

- Wind Energy Fundamentals

Comments:

Requirements for awarding the credit points

Presentation of the solutions of the calculation exercises and tasks in due time. Each set of tasks will be graded. The average of the grades obtained during its duration will be calculated, giving the final grade.

Examination periods:

Tasks corresponding to each chapter will be given to the students. The tasks are designed to be solved in 2 weeks' time frame. Deadlines to deliver the tasks will be at the end of each month.

Useful literature:

- Burton, T., N. Jenkins, D. Sharpe & E. Bossanyi, 2011: Wind Energy Handbook, Second Edition, John Wiley.
- Gasch, R. & J. Twele, 2012: Wind Power Plants: Fundamentals, Design, Construction and Operation; Second Edition, Springer
- Selected papers (e.g. Wind Energy Science, Wind Energy, …)

Registration procedure:

C3LLO

Last update: 30.09.2017