Module level	Credit points	Language	Return
Master	6	English	annual

Module designation

Design of Mechanical and Electrical Components

Course(s)

1. Mechanical Aspects of Wind Energy
2. Electrical Aspects of Wind Energy

Code	Subtitle
Person responsible for the module	Prof. Dr. rer. nat. Clemens Hoffmann
Lecturer	1. Prof. Dr. Siegfried Heier 2. Prof. Dr. Henry Seifert
Workload	180 h (30h contact time, 150h private study)
Relation to curriculum	Basic studies, compulsory optional subject
Type of teaching, contact hours	Skype, virtual classrooms, digital communications
Requirements according to examination regulations	None

Recommended prerequisites None

Module objective / intended learning outcomes

The students should be able

- to design different wind turbine components
- to compute the rotor-blade aerodynamics and determine the optimum blade setting angles for design mean flow speed
- to compute the forces and performance curves for the wind turbine
- to determine the basic wind turbine dimensions
- to compare different design concepts for power delivery systems
- to design the different gear boxes and mechanical drives in the machine house
- to understand the safety and braking systems needed in the machine house
- to design the different tracking mechanisms
- to compute the different aerodynamic, structural and dynamic loads on the wind turbine blades and tower
- to estimate the extra loads from the mechanical systems connected to the wind turbine
- to distinguish between the different materials used to construct the rotor blades
- to design rotor blades using different available materials and technology
- to distinguish and know about the different types of towers and support used for wind turbines
- to make a preliminary design for a tubular, concrete or lattice tower and suitable foundation
- to understand the different legislation requirements and transportation facilities needed to build and operate a wind turbine/farm
- to plan for a new wind farm and to develop a Gantt chart to define when the different design, construction, testing and operation will commence
- to understand the different safety measures and necessary scheduled maintenance for wind turbines
- to take appropriate steps to apply for wind farm certification.

The students should be able

- to understand and know the different WEC devices and functions
- to describe the different components of WECS
- to calculate the blade setting and obtain the performance curves

- to match the turbine to a suitable generator
- to describe the suitable drive train
- to understand the different problems related with grid integration
- to understand and know the different types of grids
- to understand schemes for control of the grid
- – to design wind turbine control concepts for island, grid and interconnected operation

Module content

Mechanical drive train and machine house: comparison of different design concepts, blade adjustment system, rotor brake, step up gears, generator coupling, tracking of wind direction, machine house design, aesthetic criteria; loads and structural demands: static aerodynamic and structural loads on blades and towers, dynamic loads on blades and towers, modeling to calculate the loads and structural demands, mechanical components and control system loads; rotor blades in composite construction: materials, composite material construction, rotor blade construction, rotor blade connection to the hub; towers and foundation: design and varieties, steel tube towers, concrete tower, lattice tower, foundation; planning, installation and operation: project planning, legislations for land and environmental operation, transport facilitations for wind farm, plant erection, testing and operation, safety aspects, service and maintenance; certification of wind power plants; field excursion to German wind farm sites.

Construction and functional structures of WEC; main components of wind energy converters: rotor blade with pitch drive, input torque, generator, mechanical drive train; grid integration: different electrical networks, grid influences, grid control; control concepts and operational results: island grid operation of WECs, grid operation, interconnection operation; control system design and plant simulation: plant components characteristics, development of mathematical models for control and simulation, dimensioning of the controllers.

Study and examination requirements and forms of examination	Written exam (120 min) or online oral examination (30 min) or written homework (25 pages) with presentation of the homework (30 min). The examinations are going to 75% (written homework) of the shares and 25% (presentation) in the final grade of the module.
Media employed	online script

Reading list

S. Heier and R. Waddington, *Grid Integration of Wind Energy Conversion Systems*, Wiley-Blackwell, 2nd edition, 2006.

E. Hau and H. von Renouard, *Wind Turbines: Fundamentals, Technologies, Appli-cation, Economics*, Springer; 2nd edition, 2005.