Module level Master	Credit points 6	Language English	Return annual
Module designation Wind Energy Meteorology			
Course 1. Mathematical analysis of prognoses and model development 2. Wind Energy Meteorology			
Code	**Subtitle**		
Person responsible for the module	Prof. Dr. rer. nat. Clemens Hoffmann		
Lecturer	1. Prof. Dr. rer. nat Heinrich Werner 2. Dr. Bernhard Lange		
Workload	1. 90 h (10h online presentation, 20h private study, 60, home work) 2. 90 h (10h online presentation, 20h private study, 60h home work)		
Relation to curriculum	Specialist studies, Electrical Systems, elective		
Type of teaching, contact hours	Online-unit, virtual classrooms, online presentation, skype		
Requirements according to examination regulations	Module Application of Software Tools		
Recommended prerequisites None			
Module objective / intended learning outcomes **Knowledge**: Students know the different types of neural networks and their application to technical problems. They can juge the ability of different types of neural networks to solve different prognosis problems in Wind power forecasting **Skill**: Students are able to construct neural models for the Weather-Power situations in Wind power forecasting in the framework of Mathlab, to train and analyse them, and to build these Models into user application programs. **Competences**: Students know how to present new Models to a non expert audience, to explain advantages and disadvantages of new approaches, and to make competent statements about the system confidence. **General knowledge:** Students should have a general knowledge about wind in the atmosphere and the underlying physical, meteorological and micometeorological theory. They should understand how wind is on the one hand the source of the power produced from wind turbines, on the other hand responsible for the loads on the turbines. They should learn the meteorological knowledge for the integration of wind power into the electricity supply system. **Wind potential / Wind power resource:** The students should gain the ability to assess, analyze and judge the wind power potential and resource. They should gain knowledge about state-of-the-art methods in wind measurement, characterization and modeling. **Design conditions:** The students should understand how the design of wind turbines depends o the wind conditions. They should know the design parameters used for wind turbine design and have the ability to assess these parameters. **Wind power integration:** They should know the basic challenges of integrating a weather dependent energy source like wind power in the electricity supply system. They should understand how wind power forecasts can help integrating wind power and acquire knowledge about the methods used for wind power prediction.			
Content			

1.

- Tools for data analysis and modelling (introductory level)
- Neural networks as a Tool for data analysis and modelling (introductory level)
- Models for data with functional behavior, feed foreward networks (basic level)
- Training methods in feed foreward networks (advanced level)
- Models for data with relational behavior, feedback networks (basic level)
- Training methods in feedback networks (advanced level)
- Application perspectives in wind power prognosis (advanced level)
- Implementation perspectives in wind power prognosis (advanced level)
- Confidence considerations in wind power prognosis (advanced level)

2. Introduction
   - Origin of wind
   - Fundamentals of atmospheric flow
   - Micrometeorology of wind
   - Wind Potential / Resources
   - Design conditions
   - Special-temporal behavior of wind
   - Wind power forecasting
   - Wind power production simulation

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

Simon Haykin: Neural Networks. A Comprehensive Foundation. 2. edition, international edition = Reprint. Prentice-Hall, Upper Saddle River NJ u. a. 1999, ISBN 0-13-273350-1.

John Hertz, Anders Krogh, Richard G. Palmer: Introduction to the Theory of Neural Computation. Addison-Wesley, Reading MA u. a. 1999, ISBN 0-201-51560-1 (Santa Fé Institute studies in the sciences of complexity. Lecture notes 1 = Computation and neural systems series).

Teuvo Kohonen: Self Organizing Maps. 3. edition. Springer, Berlin u. a. 2001, ISBN 3-540-67921-9 (Springer Series in Information Sciences 30 = Physics and Astronomy online Library).

Helge Ritter, Thomas Martinetz, Klaus Schulten: Neural Computation and Self-Organizing Maps. An Introduction. Addison Wesley, Reading MA 1992, ISBN 0-201-55442-9 (Computation and neural Systems Series).

Raul Rojas: Theorie der Neuronalen Netze. Eine systematische Einführung. 4.. Springer, Berlin u. a. 1996, ISBN 3-540-56353-9 (Springer-Lehrbuch).

Andreas Zell: Simulation neuronaler Netze. 4. unveränderter Nachdruck. Oldenbourg, München u. a. 2003, ISBN 3-486-24350-0.