Module designation

Wind Energy Meteorology

Course

1. Mathematical analysis of prognoses and model development
2. Wind Energy Meteorology

<table>
<thead>
<tr>
<th>Code</th>
<th>Subtitle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person responsible for the module</td>
<td>Prof. Dr. rer. nat. Clemens Hoffmann</td>
</tr>
<tr>
<td>Lecturer</td>
<td>1. Prof. Dr. rer. nat Heinrich Werner  2. Dr. Bernhard Lange</td>
</tr>
<tr>
<td>Workload</td>
<td>1. 90 h (10h online presentation, 20h private study, 60h home work)  2. 90 h (10h online presentation, 20h private study, 60h home work)</td>
</tr>
<tr>
<td>Relation to curriculum</td>
<td>Specialist studies, Electrical Systems, elective</td>
</tr>
<tr>
<td>Type of teaching, contact hours</td>
<td>Online-unit, virtual classrooms, online presentation, skype</td>
</tr>
<tr>
<td>Requirements according to examination regulations</td>
<td>Module Application of Software Tools</td>
</tr>
</tbody>
</table>

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 judge 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 micrometeorological 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 on 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 forward networks (basic level)
   - Training methods in feed forward 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

<table>
<thead>
<tr>
<th>Study and examination requirements and forms of examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Media employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>online script</td>
</tr>
</tbody>
</table>

Reading list