Module level Master	Credit points 6	Language English	Return annual
Module designation Rotor Aerodynamics			
Course(s) Rotor Aerodynamics			
Code	**Subtitle**		
Person responsible for the module	Prof. Dr.-Ing. Martin Lawerenz		
Lecturer	Prof. Dr.-Ing. Martin Lawerenz		
Workload	180 h (42 h lecture, 42 h exercise, 21 h online session, 75 h examination preparation)		
Relation to curriculum	Specialist studies, simulation and structural technology, elective		
Type of teaching, contact hours	Online-unit, telephone, skype, digital communications		
Requirements according to examination regulations	Module Fluid Mechanics		
Recommended prerequisites Modules Theoretical Fluid Mechanics			
Module objective / intended learning outcomes Upon completion of the course, students will have abilities to assess and analyze the flow field of wind turbine rotors and will be able to perform basic aerodynamic design of the blades. - Knowledge: Aerodynamics of wind turbine rotor - Skills: Performance estimation of wind turbine, aerodynamic design of rotors, numerical simulation-methods. - - Competences: Analysis and assessment of wind turbine flow-field, and the corresponding energy transmission.			
Content • Introduction. • Basic Aerodynamics. – Coordinate System & Velocity Triangle. – Aerodynamic Variables. – Dimensionless Parameters. – Conservation Laws. • Wind Turbine Model. – Representation of Wind Turbine Flow-Field. – Betz's Law of Maximum Power. – 2-D Representation of Wind Turbine Flow-Field. – Extensions for Vortical Flow. • Blade Element Method. – Classical Blade Element Method. • Airfoil Aerodynamics. – Potential Flow – Streamline Curvature Method – Stream-Function Method – Viscous Flow – Boundary Layer Concept – Laminar and Turbulent Boundary Layers – Loading of Boundary Layer & Separation			

- Aerodynamic Losses
  - Definition
  - Losses in 2-D Flow
  - Losses in 3-D Flow
- Boundary Conditions.
  - Inflow Wind
  - Wind Shear
  - Gust Loads
  - Flow near the Tower.
- Aerodynamic Design of the Rotor.
  - Objectives
  - Constraints
  - Optimization Methods
  - Optimization of Wind Turbine Rotor
- Numerical Simulation of Wind Turbine Flow (Examples).
  - Steady-state Navier-Stokes Simulation
  - Unsteady Navier-Stokes Simulation
  - Rotor-Tower Interaction
  - Dynamic Inflow.

Study and examination requirements and forms of examination	Written Test (60min) or oral examination (30 min.)
Media employed	online script

Reading list

Hansen, M. O. L.: Aerodynamics of Wind Turbines, 2nd Edition, Earthscan, London, 2008

Spera, D.:Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering *ASME Press, 2009*