Module level Master	Credit points 6	Language English	Return annual
Module designation Linear Computational Structural Mechanics			
Course(s) Linear Computational Structural Mechanics			
Code	**Subtitle**		
Person responsible for the module	Prof. Dr.-Ing. Detlef Kuhl		
Lecturer	Prof. Dr.-Ing. Detlef Kuhl		
Workload	180 h (30h contact time, 90h private study, 60h homework)		
Relation to curriculum	Specialist studies, Simulation and Structural Technology, elective		
Type of teaching, contact hours	Chapter-Checks, virtual classroom, online scripts, digital communication		
Requirements according to examination regulations	Modules Mathematic, Solid Mechanic		

Recommended prerequisites

Modules Application of Software Tools

Module objective / intended learning outcomes

This course provides an introduction to linear computational structural mechanics using the finite element method and dynamics solution procedures. It is based on the fundamental education in mathematics, solid mechanics and application of software tools. Subsequent courses in solid mechanics structural technology and fluid structure interaction as one particular ingredient of the fluid mechanics courses are using the basic knowledge of computational structural mechanics. The present course is continued in Nonlinear Computational Structural Mechanics.

At the end of the course, the students should:

- Understand the basic theory of the finite element method including the initial boundary value problem, the weak formulation and the discretization in space and time
- Have knowledge off different finite element formulations, their advantages and disadvantages, their strengths and limitations
- Understand the static solution process using the finite element methods
- Knowing the eigenvalue analysis and its application to wind power plants
- Knowing different types of time integrations schemes and their properties
- Be able to develop a basic finite element program using MATLAB
- Be familiar with the application of finite element programs to the static and dynamic analysis of wind power plant components

Content

The course Linear Computational Structural Mechanics provides the theoretical basis, the development and the application of the finite element method. Special attention is taken to the requirements for the static and dynamic analysis of wind power plants.

- Brief summary of linear continuum mechanics
- Weak formulation of elastostatics and elastodynamics
- Development of 1d-finite-element-methods
- Development of 3d- and 2d-finite-element-methods

- Development of 2d- and 3d-truss and beam elements
- Assembly, static analysis and post-processing
- Eigenvalue analysis
- Explicit and implicit dynamic solution within the time domain
- Linear finite element program development
- Numerical analyses of components of wind power plants using a MATLAB finite element code

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 materials as lecture notes, presentations, interactive learning modules and chapter checks. virtual classroom

Reading list

Textbooks on the linear finite element method, e.g.

Zienkiewicz & Taylor (2000): The Finite Element Method. Volume 1. The Basis

Hughes (1987): The Finite Element Method. Linear Static and Dynamic Finite Element Analysis

Bathe (1996): Finite Element Procedures

Szabo & Babuska (1991): Finite Element Analysis

Particular journal papers as basis of homeworks , e.g.

Babuska, Szabo & Katz (1981): The p-Version of the Finite Element Method. SIAM Journal on Numerical Analysis, (18), 515-545

Hughes, Cottrell & Bazilevs (2005): Isogeometric Analysis: CAD, Finite Elements, NURBS, Exact Geometry and Mesh Refinement. Computer Methods in Applied Mechanics and Engineering, (194), 4135-4195

Hughes & Hulbert (1988): Space-Time Finite Element Method for Elastodynamics: Formulations and Error Estimates. Computer Methods in Applied Mechanics and Engineering, (66), 339-363