Mathematical Aspects of Differential Equations and Numerical Mathematics

Module-No./Abbreviation	Credits	Workload	Term	Frequency	Duration
CE-P01/MADENM	6 CP	180 h	1st Sem.	Winter term	1 Semester

Courses	Contact hours	Self-Study	Group Size:
Mathematical Aspects of Differential Equations and Numerical Mathematics	4 SWS (60 h)	120 h	No Restrictions

Prerequisites
No prior knowledge or preliminary modules. Basic calculus and experience with matrices.

Learning goals / Competences
The course will focus on the mathematical formulation of differential equations with applications to elastic theory and fluid mechanics. It gives an introduction to geometric linear algebra with emphasis on function spaces, coupled with the elementary aspects of partial differential equations. The students should learn to understand the mathematics side of the Finite Element Method (FEM) for elliptic PDE in low dimensions, appropriate Sobolev geometries, the FEM for Dirichlet and Neumann problems. For that reason, the basic principles in methods of error estimation are described to realize the understanding of fast and efficient solvers for the resulting matrix equations. As overall learning goal, the students should attain familiarity with modern methods and concepts for the numerical solution of complicated mathematical problems.
After successfully completing the module, the students

- should understand the mathematics side of the Finite Element Method for elliptic PDE in low dimensions, appropriate Sobolev geometries, the FEM for Dirichlet and Neumann problems,
- should attain familiarity with modern methods and concepts for the numerical solution of complicated mathematical problems.

Content
Linear algebra: Basic concepts and techniques for finite- and infinite-dimensional function spaces stressing the role of linear differential operators. Numerical algorithms for solving linear systems. The mathematics of the finite element method in the context of elliptic partial differential equations (model problems) in dimension two.

Teaching methods / Language
Lecture (2h / week), Exercises (2h / week) / English
Remark: Due to the mixed background of the students, the exercise sessions often amount to additional lectures.

Mode of assessment
Written examination (120 min, 100%)

Requirement for the award of credit points
Passed final module examination

Module applicability (in other study programs)
MSc. Computational Engineering

Weight of the mark for the final score
4 %

Module coordinator and lecturer(s)
Prof. Dr. G. Röhrle, Assistants

Further information