Mathematical Aspects of Differential Equations and Numerical Mathematics

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Module number	Credits	Workload	Semester[s]	Duration	Group size
CE-P01/SE-C-1/MADENM	6 CP	180 h	1. Sem.	1 Semester[s]	no limitation

Courses	Contact hours	Self-study	Frequency
a) Mathematical Aspects of Differential Equations and Numerical Mathematics	a) 4 WLH (60 h)	a) 120 h	a) each winter

Module coordinator and lecturer(s)

Prof. Dr. Barney Bramham

a) Prof. Dr. Barney Bramham

Admission requirements

Recommended previous knowledge:

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

Learning outcome, core skills

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.

Contents

a)

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.

Educational form / Language

a) Tutorial (2 WLH) / Lecture (2 WLH) / English

Examination methods

• Written exam 'Mathematical Aspects of Differential Equations and Numerical Mathematics' (120 min., Part of modul grade 100 %)

Requirements for the award of credit points

• Passed final module examination
Module applicability • M.Sc. Computational Engineering • M.Sc. Subsurface Engineering
Weight of the mark for the final score Percentage of total grade [%] = 6 * 100 * FAK / DIV FAK: The weighting factors can be taken from the table of contents. DIV: The values can be taken from the table of contents.
Further Information Remark: Due to the mixed background of the students, the exercise sessions often amount to additional lectures.