UNIVERSITY OF GOTHENBURG

# DEPARTMENT OF MATHEMATICAL SCIENCES

## NFMV009 Finite Element Methods, 7.5 credits

Finita Element Metoder, 7,5 högskolepoäng

*Third-cycle level / Forskarnivå*

## Confirmation

This syllabus was confirmed by the Department of Mathematical Sciences on 2019-10-10, and was last revised on 2019-10-10. The revised course syllabus is valid from Autumn semester 2020.

*Responsible Department*
Department of Mathematical Sciences, Faculty of Science

## Entry requirements

Some experience with partial differential equations,, finite element methods, functional analysis and Sobolev spaces, corresponding to, e.g., Chapter 5 of S. Larsson and V. Thomee, Partial Differential Equations with Numerical Methods, Texts in Applied Mathematics 45, Springer (2003).

## Learning outcomes

After completion of the course the Ph.D. student is expected to be able to:

* understand the fundamental tools in the analysis of finite element methods

## Course content

In this course we first study how to construct finite element function spaces based on triangular or rectangular element domains and piecewise polynomials. Then we develop the associated approximation theory based on averaged Taylor polynomials and Riesz potentials. This leads to interpolation error estimates in Sobolev norms. We then consider convergence of adaptive schemes. In the second part of the course we focus on applications of the theoretical framework to other equations.

The first part of the course is based on Chapters 0-4 and 9 in The Mathematicla Theory of Finite Element Methods, by Brenner & Scott, with emphasis on Chapters 3 and 4. In the second part we will consider selected topics from the remaining chapters as well as other material. In the

second part, the participants will take an active role in selecting and presenting the material.

The course covers important results from the theory of Sobolev spaces, variational formulation of elliptic boundary value problems and the formulation of the finite element method, construction of finite elements, polynomial approximation theory in Sobolev spaces, convergence of adaptive algorithms as well as applications of the theoretical results to other equations.

## Types of instruction

Lectures 2 x 2h per week. In the second part of the course, the participants will hold presentations.

*Language of instruction*
The course is given in English.

## Grades

The grade Pass (G) or Fail (U) is given in this course.

## Types of assessment

To pass the course, the student must:

* pass a number of written home assignments

* give a lecture on a topic relevant to the course.

Standard Disclaimer:

A Ph.D. student who has failed a test twice has the right to change examiners, if it is possible. A written application should be sent to the Director of Graduate Studies.

In cases where a course has been discontinued or major changes have been made, a Ph.D. student should be guaranteed at least three examination occasions (inlcuding the ordinarily scheduled exam) during a period of at least one year from the last time the course was given.

## Course evaluation

Decided by the teacher.