# SF2561 Finita elementmetoden 7,5 hp

## The Finite Element Method

När kurs inte längre ges har student möjlighet att examineras under ytterligare två läsår.

## Fastställande

Kursplan för SF2561 gäller från och med HT13

## Betygsskala

A, B, C, D, E, FX, F

## Utbildningsnivå

Avancerad nivå

## Huvudområden

Matematik,Teknik

## Särskild behörighet

Single course students: 90 university credits including 45 university credits in Mathematics
or Information Technology. English B, or equivalent.

## Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

## Lärandemål

Basic laws of nature are typically expressed in the form of partial differential equations (PDE), such as Navier's equations of elasticity, Maxwell's equations of electromagnetics,Navier-Stokes equations of fluid flow, and Schrödinger's equations of quantum mechanics. The Finite element method (FEM) has emerged as a universal tool for the computational solution of PDEs with a multitude of applications in engineering and science. Adaptivity is an important computational technology where the FEM algorithm is automatically tailored to compute a user specified output of interest to a chosen accuracy, to a minimal computational cost.

This FEM course aims to provide the student both with theoretical and practical skills, including the ability to formulate and implement adaptive FEM algorithms for an important family of PDEs.

The theoretical part of this course deals mainly with scalar linear PDE, after which the student will be able to

- derive the weak formulation
- formulate a corresponding FEM approximation;
- estimate the stability of a given linear PDE and it's FEM approximation;
- derive a priori and a posteriori error estimates in the energy norm, the L2-norm, and linear functionals of the solution;
- state and use the Lax-Milgram theorem for a given variational problem.

Having completed the practical part of the course the student will be able to:
modify an existing FEM program to solve a new scalar PDE (possibly nonlinear);

- implement an adaptive mesh refinement algorithm, based on an a posteriori error
- estimate derived in the theoretical part;
- describe standard components in FEM algorithms.

## Kursinnehåll

- FEM-formulation of linear and non-linear partial differential equations, element types and their implementation, grid generation, adaption and error control, efficient solution algorithms (e.g. by a multigrid method).
- Applications to stationary and transient diffusion processes, elasticity, convectiondiffusion,
  Navier-Stokes equation, quantum mechanics etc

## Kurslitteratur

To be announced at least 4 weeks before course start at course web page. Previous year:
K. Eriksson, D. Estep, P. Hansbo, C. Johnson: Computational Differential Equations.
Studentlitteratur, ISBN 91-44-49311-8

## Examination

- LAB2 - Laboration, 4,5 hp, betygsskala: P, F
- TEN2 - Tentamen, 3,0 hp, betygsskala: A, B, C, D, E, FX, F

Examinator beslutar, baserat på rekommendation från KTH:s handläggare av stöd till studenter med funktionsnedsättning, om eventuell anpassad examination för studenter med dokumenterad, varaktig funktionsnedsättning.

Examinator får medge annan examinationsform vid omexamination av enstaka studenter.

- LAB2 - Laboratory Task, 4.5 credits, grade scale: P, F
- TEN2 - Examination, 3.0 credits, grade scale: A, B, C, D, E, FX, F

## Övriga krav för slutbetyg

- Examination (TEN2; 3 university credits).
- Assignments (LAB2; 4.5 university credits).

## Etiskt förhållningssätt

- Vid grupparbete har alla i gruppen ansvar för gruppens arbete.
- Vid examination ska varje student ärligt redovisa hjälp som erhållits och källor som använts.
- Vid muntlig examination ska varje student kunna redogöra för hela uppgiften och hela lösningen.