

MATH-468

Numerics for fluids, structures & electromagnetics

Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Computational science and engineering minor	H	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
Nuclear engineering	MA1	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Oral
Workload	150h
Weeks	14
Hours	4 weekly
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Remark

Pas donné en 2025-26 *** Cours donné en alternance tous les deux ans.

Summary

Cours donné en alternance tous les deux ans

Content**Keywords**

Partial differential equations, saddle point problems, finite element method, Galerkin approximation, stability and convergence analysis.

Learning Prerequisites**Required courses**

Analysis I II III IV, Numerical Analysis, Numerical Approximations of PDEs

Recommended courses

Sobolev spaces and elliptic equations,

Important concepts to start the course

- Basic knowledge of functional analysis: Banach and Hilbert spaces, L^p spaces.
- Some knowledge on theory of PDEs: classical and weak solutions, existence and uniqueness.
- Basic concepts in numerical analysis: stability, convergence, condition number, solution of linear systems, quadrature formulae, finite difference formulae, polynomial interpolation.
- Basic information on finite element theory for elliptic problems

Learning Outcomes

By the end of the course, the student must be able to:

- Identify features of a PDE relevant for the selection and performance of a numerical algorithm.
- Assess / Evaluate numerical methods in light of the theoretical results.
- Implement numerical methods for saddle point problems

- Choose an appropriate method to solve a given differential problem
- Prove convergence of a discretisation scheme

Transversal skills

- Write a scientific or technical report.
- Make an oral presentation.

Teaching methods

Ex cathedra lectures, exercises in the classroom and computer lab sessions.

Expected student activities

- Attendance of lectures.
- Completing exercises.
- Solving problems with an academic software as Free FEM ++

Assessment methods

Oral

Supervision

Office hours	Yes
Assistant.e.s	Yes
Forum	Yes

Resources

Bibliography

- S.C. Brenner, L.R. Scott. *The Mathematical Theory of Finite Element Methods*. Springer 2007.
- A. Ern, J-L. Guermond, *Theory and Practice of Finite Elements*. Springer 2004.
- D. Boffi, F. Brezzi, M. Fortin *Mixed Finite elements and Applications*, Springer Verlag. 2013.

Ressources en bibliothèque

- [The Mathematical Theory of Finite Element Methods / S.C. Brenner & L.R. Scott](#)
- [Mixed Finite elements and Applications / D. Boffi, F. Brezzi & M. Fortin](#)
- [Theory and Practice of Finite Elements / A. Ern & J-L. Guermond](#)

Notes/Handbook

Notes for each lectures will be provided every week.

Moodle Link

- <https://go.epfl.ch/MATH-468>

Videos

- [http://Recording of the lectures will be provided after each lecture.](#)