MATH-456 **Numerical analysis and computational mathematics**

Grigori Laura

Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Financial engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The course provides an introduction to scientific computing. Several numerical methods are presented for the computer solution of mathematical problems arising in different applications. The software MATLAB is used to solve the problems and verify the theoretical properties of the numerical methods.

Content

- Numerical approximation of nonlinear equations.
- Interpolation, approximation of functions and data.
- Numerical integration and derivation.
- Numerical Linear Algebra (direct and iterative methods).
- Numerical approximation of eigenvalue problems.
- Numerical methods for Ordinary Differential Equations.
- Stability, conditioning, and convergence properties of the numerical methods; error analysis.
- Implementation of the numerical algorithms in MATLAB.

Keywords

Numerical Analysis; Computational Mathematics; numerical approximation; numerical algorithms; MATLAB.

Learning Prerequisites

Required courses

Analysis (Calculus); Linear Algebra.

Important concepts to start the course

Basic knowledge of MATLAB or GNU Octave software; basic programming.

Learning Outcomes

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

- Choose a numerical method for solving a specific mathematical problem.
- Interpret the numerical results based on the theory.
- Apply and implement the numerical algorithms for the solution of mathematical problems.

- Assess / Evaluate the numerical errors.
- State , prove, and validate the theoretical properties of the numerical methods.
- Describe the numerical methods.

Transversal skills

- Use a work methodology appropriate to the task.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

Teaching methods

Ex cathedra lectures; theoretical and practical exercises in the computer room.

Expected student activities

Attending the lectures and exercise sessions. Solving and completing the assigned exercises during and after the exercise sessions.

Assessment methods

Written exam, in the computer room. The exam covers all the theoretical and practical arguments considered at the lectures and exercises. Part of the questions and problems are solved numerically with MATLAB; the exam includes the implementation and programming of numerical algorithms in MATLAB.
In the case of art.3 al.5 from the rulebook of the Section of Mathematics, the teacher decides the form of the exam and communicates it to the concerned students.

Supervision

Office hours	Yes
Assistants	Yes

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

A. Quarteroni, F. Saleri, P. Gervasio, Scientific Computing with MATLAB and Octave, 4th ed., Springer-Verlag, Berlin and Heidelberg, 2014.
A. Quarteroni, R. Sacco, F. Saleri, Numerical Mathematics, 2nd ed., Springer, Berlin, 2007.

Ressources en bibliothèque

- (electronic version)
- Scientific Computing with MATLAB and Octave / Quarteroni & al.
- (electronic version)
- Numerical mathematics / Quarteroni & al.

Moodle Link

- https://go.epfl.ch/MATH-456