

MATH-251(a) **Numerical analysis**

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Cursus	Sem.	Type
Civil Engineering	BA5	Obl.
Environmental Sciences and Engineering	BA5	Obl.
HES - SIE	H	Obl.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	3 weekly
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course offers an introduction to numerical methods for the solution of mathematical problems as: solution of systems of linear and non-linear equations, functions approximation, integration and differentiation and solution of differential equations.

Content

- Iterative methods for solving non-linear equations.
- Polynomial approximation: interpolation and least square methods.
- Numerical integration and differentiation.
- Solution of systems of linear equations: direct and iterative methods.
- Numerical approximation of differential equations.
- Introduction to MATLAB/OCTAVE software.

Keywords

Numerical algorithms; polynomial interpolation; numerical integration; numerical linear algebra; numerical solution of ODEs; iterative methods.

Learning Prerequisites**Required courses**

Analyse, Algèbre linéaire

Recommended courses

Programmation Matlab (GC), Informatique pour l'ingénieur (SIE).

Important concepts to start the course

Analysis, linear algebra and programming.

Learning Outcomes

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

- Choose a numerical method for solving a specific problem.
- Interpret obtained numerical results from a theoretical perspective.
- Estimate numerical errors.
- Prove theoretical properties of numerical methods.
- Implement numerical algorithms.
- Apply numerical algorithms to specific problems.
- Describe numerical methods.
- State theoretical properties of mathematical problems and numerical methods.

Transversal skills

- Use a work methodology appropriate to the task.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

Teaching methods

Ex cathedra lectures; exercises in class and with computer using MATLAB/OCTAVE software.

Expected student activities

- Class attendance.
- Solution of exercises.
- Solution of problems using MATLAB/OCTAVE software.

Assessment methods

The exam may require to use a computer and MATLAB/OCTAVE software.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

In English:

- Lecturer notes.
- A. Quarteroni et F. Saleri et P. Gervasio: « Scientific Computing with MATLAB and OCTAVE », Springer, 2014, ISBN 978-3-642-45367-0.
- A. Quarteroni, R. Sacco et F. Saleri : « Numerical Mathematics », Springer, 2007, ISBN 978-3-540-49809-4.

In French:

- Lecture notes.
- A. Quarteroni, P. Gervasio et F. Saleri : « Calcul Scientifique : Cours, exercices corrigés et illustrations en MATLAB et OCTAVE », Springer, 2010, ISBN 978-88-470-1676-7.
- A. Quarteroni, R. Sacco et F. Saleri : « Méthodes Numériques - Algorithmes, analyse et applications », Springer, 2007, ISBN 978-88-470-0495-5.
- J. Rappaz et M. Picasso: "Introduction à l'analyse numérique", PPUR - Collection: Enseignement des mathématiques - 2em édition - 2011

Ressources en bibliothèque

- [\(electronic version\)](#)
- [Calcul Scientifique / Quarteroni & al.](#)
- [Introduction à l'analyse numérique / Rappaz & Picasso](#)
- [Numerical Mathematics / Quarteroni & al.](#)
- [\(electronic version\)](#)
- [\(version en ligne\)](#)
- [\(version en ligne\)](#)
- [Scientific Computing with MATLAB and OCTAVE / Quarteroni & al.](#)
- [Méthodes Numériques / Quarteroni & al.](#)

Notes/Handbook

Lecture notes will be provided.

Videos

- <https://www.coursera.org/learn/analyse-numerique>
- <https://www.edx.org/course/matlab-octave-beginners-epflx-matlabeoctavebeginnersx>
- <https://www.edx.org/course/matlab-et-octave-pour-debutants-epflx-matlaboctavex-0>

Prerequisite for

- Numerical modelling of solids and structures
- Quantitative methods I
- Quantitative methods II