

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
<b>Hours</b>	<b>3 weekly</b>
Courses	2 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**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

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

### 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