

Engineering methods

Numerical tools

IDENTIFICATION

CODE : GCU-3-S1-EC-ONUM
ECTS : 2.0

HOURS

Lectures : 12.0 h
Seminars : 20.0 h
Laboratory : 0.0 h
Project : 0.0 h
Teacher-student
contact : 32.0 h
Personal work : 20.0 h
Total : 52.0 h

ASSESSMENT METHOD

Examination of three reports to be written for each small project (66% of the final grade).
One MCQ on Moodle (34% of the final grade).

TEACHING AIDS

Courses + introduction lecture notes + additional readings.

Training sessions to learn methods and functions with Matlab.

Four small projects for groups of two students aiming to implement with Matlab the various methods and functions applied to practical cases. The small projects will be done partly during the training sessions and partly as home work.

TEACHING LANGUAGE

French

CONTACT

M. BERTRAND-KRAJEWSKI
Jean-Luc
jean-luc.bertrand-krajewski@insa-lyon.fr
M. GARNIER Robin
robin.garnier@insa-lyon.fr
M. LIPEME KOUYI Gislain
gislain.lipeme-kouyi@insa-lyon.fr

AIMS

This module is part of the course unit GCU-S5-OUTILS-1 (Engineering tools) and contributes to:

Competences in Engineering Science:

- A1- Analyze a real or virtual system (or problem) (level 2)
- A2- Operate a model of a real or virtual system (level 2)
- A5- Process data (level 2)

Mobilizes the following competences:

- B2- Work, learn, progress autonomously (level 2)
- B3- Interact with others, work as a team (level 2)

Allows the student to work and be evaluated on the following abilities:

- enforce the main basic numerical methods to solve problems with Matlab: a) ordinary differential equation with initial conditions: the Runge-Kutta method, b) finite differences method: ordinary differential equations and elliptic, parabolic and hyperbolic differential equations.

CONTENT

- General introduction to numerical methods in Civil Engineering, demo and first use of Matlab
- Solving first and second order differential equations with initial conditions using the Runge-Kutta method
- Finite differences method (FD): general principles, choice of operators
- Solving differential equations with boundary conditions by FD, boundary conditions on the function or its derivative.
- Classification of partial differential equations (PDEs): elliptic, parabolic, hyperbolic
- FD solution of elliptic PDEs
- FD solution of parabolic PDEs (explicit, implicit and mixed implicit schemes, stability and convergence conditions)
- FD solution of hyperbolic PDEs (implicit mixed scheme)
- FD solution of differential equations with initial conditions (analogy with parabolic and hyperbolic PDEs).

Tutorials: each part of the course is the subject of specific exercises done with Matlab, either by writing specific codes and/or using Matlab functions (for example ode23, ode45, solverPDE...).

BIBLIOGRAPHY

Rappaz J., Picasso M. [1997].
Introduction à l'analyse numérique. Lausanne (Suisse) : Presses polytechniques et universitaires romandes, [diffusion Lavoisier Paris], 255 p. ISBN 288074363X.

Nougier J.-P. [2001].
Méthodes de calcul numérique (tomes 1 et 2). Paris (France) : Hermès, 332 p. et 406 p. ISBN 9782746202788 et 9782746202795.

+ Numerical Recipes on internet

+ Matlab user manuals

PRE-REQUISITE

Baccalauréat + 2 years Scientific Level

Integration, derivation, linear algebra, series development.

Use of Matlab.

INSA LYON

Campus LyonTech La Doua

20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Phone +33 [0]4 72 43 83 83 - Fax +33 [0]4 72 43 85 00

www.insa-lyon.fr