INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

DPT GENIE MECANIQUE
INSA Campus LyonTech - DPT GENIE MECANIQUE - bât. J. FERRAND
12, des rue des sports - 69621 VILLEURBANNE
Phone 0472436226

Numerical analysis

Numerical analysis of differential operators

IDENTIFICATION

CODE : GM-4-S1-EC-COANO
ECTS : 2.0

HOURS

Lectures :	10.0 h
Seminars :	24.0 h
Laboratory :	0.0 h
Project :	0.0 h
Teacher-student contact :	34.0 h
Personal work :	24.0 h
Total :	58.0 h

ASSESSMENT METHOD

Test (4h)

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. FILLOT Nicolas
nicolas.fillot@insa-lyon.fr

AIMS

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*Knowledge:
Culture in numerical analysis, partial differential equations, Finite difference scheme, Differential equations and systems, Free step scheme / linked step scheme, consistency, stability, convergence.

*Capacity:
To be able to select a numerical scheme and evaluate its advantages and drawbacks.
To be able to evaluate the quality and the cost of a numerical scheme.
To be able to read the technical documents regarding softwares, and use these sofware at their best.
To be able to implement a numerical model, by programming or using black box type functions. The privileged tool is Matlab.
To be able to interpret and lead a critical analysis on a numerical solution.

CONTENT

1. Finite difference method for partial differential equations
1.1 Introduction to stationary partial differential equations
1.2 Basic principles of the finite difference method in 1D. Illustrations et implementations.
1.3 Analysis of the method : consistency, stability and convergence
1.4 Extensions to 2D
2. Numerical schemes for initial value problems
2.1 Single-step methods : principle, analysis and implementation
2.2 Multi-steps methods (prediction-correction)
2.3 Newmark method for second order problems
2.4 Numerical solvers
2.5 Semi-discretization in space and space-time discretization

BIBLIOGRAPHY

Demailly J.P., Analyse numérique et équations différentielles, EDP Sciences, Grenoble Sciences, Saint-Martin d'Hères, 2006
Butcher J.C., Numerical methods for ordinary differential equations, Wiley, New York, 2008
Shampine L.F., Numerical solution of ordinary differential equations, Chapman Hall, New York, 1994
Allaire G., Analyse numérique et optimisation, Editions de l'Ecole Polytechnique, Palaiseau, 2005
Filbet F., Analyse numérique, algorithmes et étude mathématique, Dunod, Paris 2009.
Rappaz J., Picasso M., Introduction à l'analyse numérique, PPUR, Lausanne 1999.

PRE-REQUISITE

EC Informatique et méthodes numériques (3-GM, S1)
EC Mathématiques et éléments finis (3-GM, S2)
EC Mathématiques (3-GM, S1)
Basics in Real analysis, linear and bilinear algebra
Basics in algorithmics