UNIVERSITÀ DI PAVIA

Anno Accademico 2017/2018

NUMERICAL MODELLING

Enrollment year	2015/2016
Academic year	2017/2018
Regulations	DM270
Academic discipline	MAT/08 (NUMERICAL ANALYSIS)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	3°
Period	1st semester (02/10/2017 - 13/01/2018)
ECTS	6
Lesson hours	56 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	MOIOLA ANDREA (titolare) - 6 ECTS
Prerequisites	Numerical Analysis 1 and 2, and basic knowledge of the MATLAB language.
Learning outcomes	The course aims to integrate and extend the knowledge gained in the previous numerical analysis courses, with particular attention to the solution of boundary value problems. The fundamental objective is to present several techniques of numerical modelling, both revisiting the classic algorithms of numerical analysis and introducing new methods of approximation.
Course contents	We introduce numerical algorithms for the solution of differential boundary values problems. Elements of the MATLAB language are part of the course content. - Shooting method for linear and non-linear boundary value problems. - Diffusion-transport-reaction models.

	- Well-posedness of the Dirichlet problem in one dimension, maximum principle, Green function, other boundary conditions. - Numerical differentiation: finite differences; truncation error and round-off error. - Finite difference method. Existence, uniqueness and accuracy of the discrete solution. The Neumann problem. Efficient implementation. Diffusion-transport problem, upwind method. Eigenvalue problems. Non-linear problems. - Polynomial and trigonometric collocation method; the discrete Fourier transform and the FFT. - The weak formulation of a boundary value problem; abstract variational problems. - The Galerkin method. - The finite element method; linear and quadratic finite elements; error analysis. - Evolution problems: the heat equation, the Fourier method, the theta-method.
Teaching methods	Lectures and tutorials in the computer lab.
Reccomended or required readings	Lecture notes prepared by the lecturer. V. Comincioli, Analisi Numerica. Metodi, Modelli, Applicazioni, McGraw-Hill, 1995. A. Iserles, A First Course in the Numerical Analysis of Differential Equations, Cambridge University Press, 2009. R.J. LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations. Steady-state and Time-dependent Problems, SIAM 2007. A. Quarteroni, Modellistica Numerica per Problemi Differenziali, Springer, 2016. A. Quarteroni, R. Sacco, F. Saleri, P. Gervasio, Matematica Numerica, Springer, 2014. G. Strang, G. Fix, An Analysis of the Finite Element Method, Wellesey–Cambridge press, 2008 (1st ed. 1973). E. Suli, D. Mayers, An introduction to Numerical Analysis, Cambridge University Press, 2003. A. Tveito, R. Winther, Introduction to Partial Differential Equations. A Computational Approach, Springer 2005.
Assessment methods	Written and oral exam with discussion of MATLAB reports.
Further information	
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile