Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Course "Analisi Numerica"

- Code: DT0021
- Type of course unit:
- Level of course unit:
- Semester: 2

Number of ects credits:

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1	**Course objectives**	Provide the mathematical instruments for the numerical solution of basic problems in applied sciences and create the ability to develope algorithms by means of Matlab, a structured programming language.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Error analysis: Computer representation of real numbers. Propagation of errors. Truncation and rounding. Errors in summation. Propagation of errors. Problem conditioning and algorithm stability. • Numerical linear algebra: vectors, matrices and their properties. Norms. Eigenvalues and spectral radius. Relations between norms and spectral radius. Classes of particular matrices (Hermitian matrices, definite positive, etc.). Direct methods for solving linear systems: triangular systems, Gauss elimination method, pivoting. LU and LL ^ H factorizations. Cholesky factorization. Conditioning of a linear system. Conditioning numbers. Backward analysis. • Calculation of eigenvalues and eigenvectors: localization of eigenvalues in the complex plane. Perturbation theorems for eigenvalues. Power method and variant of Wielandt for the determination of eigenvalues and eigenvectors of matrices. Overview of the QR method. • Interpolation and approximation: calculation of an algebraic polynomial in one point. Polynomial interpolation. Lagrange form. Linear interpolation operator. Interpolation error. Chebyshev polynomials: recursive formula, zeros, minimum norm properties. Calculation of the interpolation polynomial. Newton's formula of divided differences. The problem of the convergence of interpolator schemes. Interpolation by piecewise polynomials. Spline functions. Calculation of the cubic spline. • Quadrature formulas: general form of a formula. Polynomial order. Interpolatory formulas. Convergence theorem. Newton-Cotes formulas. Gaussian formulas. Empirical estimation of the error. Composite formulas: trapezoids and Simpson. Romberg method. Adaptive quadrature. • Iterative methods for the solution of large linear systems: splitting methods; general convergence theorem; error checking; iterative methods of Jacobi and Gauss Seidel; convergence theorem for the Jacobi method applied to strongly weakly dominant diagonal systems. • MATLAB programming: files, functions, arrays and data structures, Matlab operators, data formatting, commands and functions Matlab of utilities, commands for graphs. Application of Matlab to Numerical Analysis: creation of Matlab programs and functions in the laboratory concerning linear systems, non-linear equations, interpolation of data and functions, eigenvalues and eigenvectors. On successful completion of this module, the student should : • have a good knowledge and understanding of the main concepts and techniques of Numerical Analysis; be able to apply his knowledge and understanding to deal numerically, using a programming tool (Matlab), Mathematics and Engineering problems; demonstrate skill in mathematical and numerical reasoning; understand and explain the main notions and results of Numerical Analysis; demonstrate reading and comprehension skills of other texts on related topics.
3	**Course prerequisites**	Mathematical Analysis and Linear Algebra

4	**Teaching methodsand language**	Written test, lab test (optional oral test) **Language**: Italian **Reference textbooks** • E.Isaacson, H.Keller, ***Analysis of numerical methods***. J.Wiley & sons, New York. 1966. • G.Monegato, ***Calcolo Numerico***. Levrotto e Bella, Torino. 1985. • J.Stoer, R.Bulirsch, ***Introduction to Numerical Analysis***. Springer Verlag. 1993. • W. J. Palm III, ***Matlab 6 per l'Ingegneria e le Scienze***. Mc Graw Hill. 2003. • D. Bini, M. Capovani e O. Menchi, ***Metodi numerici per l'algebra lineare***. Zanichelli. 1988.
5	**Assessment methods**	Written test, lab test (optional oral test)