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 E Complementi Di Matematica"

- Code: I0644
- Type of course unit: Elective (Laurea in Ingegneria dell'Informazione curriculum Automatica)
- Level of course unit: Undergraduate Degrees
- Semester: 1

Number of ects credits: (Laurea in Ingegneria dell'Informazione) 6 (workload 150 hours)

Teachers: Maria Gabriella Cimoroni (mariagabriella.cimoroni@univaq.it)

1	**Course objectives**	Provide mathematical tools of Complex Analysis and Numerical Analysis suitable for mathematical and numerical solutions of the basic problems of applied sciences and the development of algorithms in a structured programming language.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Elements of complex analysis: the field of complex numbers. Functions of complex variable. Holomorphic functions. Line integrals. Primitives of functions of complex variable. Power series. Analyticity of holomorphic functions. Laurent's series. Zeroes of holomorphic functions. Isolated singularity for holomorphic functions. Residues. Residues' Theorem and its applications. • Fourier Transform: definition. Properties. Transform of convolutions. Applications of the Fourier Transform. • Computer representation of numbers: floating point representation. Accuracy of floating point representation. Error analysis: Chopping and rounding. Loss of significance errors. Error and relative error. Condition number of a problem and stability of a numerical algorithm. • Equations and non-linear systems: roots of non-linear equations. Bisection method. Fixed point method. Banach theorem. Local convergence theorem of the fixed point method. Newton's method for simple and multiple roots. Theorem of global and local convergence. Newton's method for non-linear systems. Convergence, convergence order and efficiency of an iterative method. • Cauchy problems for ordinary differential equations: generalities. Transformation of a scalar Cauchy problem of order n in a first order vectorial problem. Explicit and implicit one-step methods; fixed stepsize algorithms. Local truncation and global errors. Analysis of the local unitary truncation error. Explicit Runge-Kutta methods with r stages. Consistency and convergence of the Euler method and of one-step methods. • MATLAB programming: functions and data structures, arrays, files, Matlab operators, data formatting, commands and functions Matlab of utilities, commands for graphs. Application of Matlab to Numerical Analysis: realization in the laboratory of Matlab programs and functions concerning non-linear equations and Cauchy problems. On successful completion of this module, the student should : • have a good knowledge and understanding of the main concepts and techniques of Complex Analysis and of Numerical Analysis, • be able to apply his knowledge and understanding to deal with basic problems on Applied Mathematics and Engineering, • demonstrate skills in mathematical and numerical reasoning, • understand and explain the main notions and results of Complex and Numerical Analysis, • demonstrate capacity for reading and understand other texts on related topics.
3	**Course prerequisites**	Mathematical Analysis II
4	**Teaching methodsand language**	Lectures and exercises and laboratory exercises **Language**: Italian **Reference textbooks** • A. Quarteroni, ***Elementi di Calcolo Numerico*** . Progetto Leonardo, Bologna.

		• A. Quarteroni, R. Sacco, F. Saleri, ***Esercizi di Calcolo Numerico risolti con MATLAB***. Progetto Leonardo, Bologna. • W.J. Palm III, ***MATLAB 6 per l'Ingegneria e le Scienze***. Mc. Graw-Hill. • G. Di Fazio, M. Frasca, ***Metodi Matematici per l'Ingegneria***. Monduzzi. • M. Codegone, ***Metodi Matematici per l'Ingegneria***. Zanichelli.
5	**Assessment methods**	Written and oral exam and laboratory practical exam