



COURSE: Numerical Analysis	
ACADEMIC YEAR: 2017/2018	
TYPE OF EDUCATIONAL ACTIVITY: Characteristic	
TEACHER: Concetta Laurita	
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Language: Italian	

ECTS: 6	n. of total hours: 54 n. of hours of lessons: 32 n. of hours of practice: 22	Campus: Potenza School of Engineering Program: Mechanical Engineering	Semester: First
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#### EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

To know the main numerical methods applied in different contexts.

To be able to choose between antagonists methods for solving a specific problem (eg, comparing the order of convergence, stability of algorithms, computational cost).

To achieve a good level in programming algorithms, for example, in Matlab in order to apply the studied numerical methods.

To be able to read the numerical results provided by the machine when a numerical procedure is implemented.

To be able to communicate, in written and oral form, the studied numerical problems and the related resolution methods to argue about the choice of the most competitive procedure to use.

The activities aim to provide a methodology and a capacity to address and solve numerical problems that are not necessarily the same as those dealt with during the course.

#### PRE-REQUIREMENTS

The knowledge of the arguments from Calculus and Linear Algebra, basic of computer science and Matlab programming fundamentals. The knowledge of the arguments from Calculus and Linear Algebra, basic of computer science and Matlab programming fundamentals.

#### SYLLABUS

##### **Errors and computer arithmetic**

Single and double precision. Absolute and relative error. Machine precision. Conditioning of a problem and algorithm stability. Numerical cancellation.

##### **Numerical methods for linear systems**

Condition number. Back and forward substitution. Gauss elimination, pivoting. LU factorization. Cholesky factorization.

##### **Numerical methods for the solution of nonlinear equations**

Bisection method. Newton method.

##### **Approximation of functions**

Algebraic polynomial approximation by Lagrange interpolation. Interpolation by piecewise polynomial functions. Spline functions.

##### **Numerical integration**

Quadrature formulas. Stability, convergence, degree of accuracy, error estimation. Newton-Cotes quadrature rules. The trigonometric quadrature formula.

##### **Numerical differentiation**

Finite difference methods.

##### **Numerical methods for the solution of ODE**

The Initial Value Problem. Onestep and multistep methods. Runge-Kutta methods. Predictor-corrector methods.

**Practical implementation of the studied algorithms in Matlab**

**TEACHING METHODS**

Theoretical lessons, Laboratory tutorials.

**EVALUATION METHODS**

Practical test and oral examination.

The aim of the examination is to test the level of achievement of the previously mentioned educational goals.

The exam is divided into 2 parts:

- a practical test with the computer (resolution of three numerical exercises) on all the topics covered in the course; the test is intended to assess the understanding of the topics and the ability to choose between the different methods studied in the numerical solution of a specific problem. The student who does not show sufficient knowledge of the subjects is not admitted to the oral test; to pass the test one must acquire at least 18 points out of 30. The estimated time for the test is 2.5 hour.
- an oral test which will evaluate the ability to link and compare different aspects covered during the course; to pass the test one must acquire at least 18 points out of 30.

**TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL**

Lecture notes and teaching material for exercises provided by the teacher, available on a shared folder with the students enrolled in the course.

**TEXTBOOKS**

- G. Monegato, Fondamenti di Calcolo Numerico, CLUT (Torino)
- A. Quarteroni, R. Sacco, F. Saleri, Matematica Numerica, Springer

**INTERACTION WITH STUDENTS**

At the beginning of the course, after describing the objectives, program and evaluation methods, the teacher collects the list of students who intend to enroll in the course, together with name, serial number and email.

The teacher at the beginning of the discussion on each item makes available the lecture notes on the online learning platform of the University of Basilicata.

Office hours: Monday and Wednesday from 15.30 to 17.30.

In addition to weekly reception, the teacher is available at all times for a contact with the students through their e-mail.

**EXAMINATION SESSIONS (FORECAST)<sup>1</sup>**

20/02/2018, 22/03/2018, 24/04/2018, 24/05/2018, 21/06/2018 18/07/2018, 25/09/2018, 25/10/2018, 22/11/2017, 20/12/2018

SEMINARS BY EXTERNAL EXPERTS    YES     NO

**FURTHER INFORMATION**