**Numerical Treatment of Functional Equations – Module A**

**Language**

Italian (English on request)

**Contents**

- Approximation of periodic functions by means of trigonometric polynomials
- Numerical methods for the global approximation of the solution of Fredholm integral equations of the second kind having periodic given functions

**Books**

- Lecture notes in pdf form (Italian)

**Course goals or objectives**

The aim of the course is to know and to apply stable and convergent numerical methods for the global approximation of the solution of some functional equations (in particular, Fredholm integral equations of the second kind).

Moreover, the course will give the approximation theory tools for the construction of the numerical methods. In particular, in Module A, the approximation of periodic functions by means of trigonometric polynomials will be considered.

By the end of Module A students should be able to:

- understand the basic ideas of approximation theory;
- connect structural properties of a periodic function with the order of convergence of its best polynomial approximation;
- know the behavior of polynomial approximation processes, such as Fourier sums and Lagrange interpolation, in different function spaces;
- know and apply numerical methods for the global approximation of the solution of Fredholm integral equations of the second kind having periodic given functions;
- discuss the stability and the convergence of these numerical methods;
- implement algorithms related to these numerical methods and comment the numerical results, comparing them with the theoretical estimates.

**Prerequisites**

- mathematical analysis (differential and integral calculus for functions of one or several variables, sequences and series, normed spaces, linear operators, elements of complex analysis)
- linear algebra and geometry (linear spaces, linear systems, linear maps, eigenvalues, orthonormal bases)
- numerical analysis (errors, quadrature rules, linear systems)
- elements of computer programming (MatLab)
Teaching methods

- Lectures
- Laboratory exercises

The active participation of the students will be encouraged both during the lectures and the laboratory exercises. Then, the students will have the possibility to take part to mid-course oral and/or practical tests to check their learning level.

Means of evaluation

Oral exam at the end of the course

Detailed contents


- **Quadrature rules.** Error estimates of the trigonometric quadrature rule in Sobolev spaces.