PHD COURSE

APPLICABLE APPROXIMATION THEORY

A.A. 2016/2017

Teacher: Luisa Fermo

Academic Field: 01/A5 (MAT/08) Numerical Analysis

CFR: 4

Semester: Second (April-May).

Students who are interested should contact the teacher via email to the address fermo@unica.it or in person at the Department of Mathematics and Computer Science located at Viale Merello 92 by February 15th.

Prerequisites:

(a) Mathematical Analysis (differential calculus and integral calculus, normed spaces, Banach spaces, Hilbert spaces);

(b) Linear algebra (vector spaces, linear systems, eigenvalues, orthonormal bases);

(c) Elements of Matlab.

Scopes: Gaining applicable knowledge :

- of the results of the approximation theory, which are essential for numerical integration and for solutions of Fredholm integral equations;
- of the numerical methods to compute integrals and solve Fredholm integral equations.

At the end of the course, students should be able to

- establish tho order of approximation of a given function by means of algebraic or trigonometric polynomials;
- choose the most appropriate quadrature formula to approximate a given integral according to the smoothness properties of the integrand function;
- solve Fredholm integral equations of the second kind;
- write the related algorithms (numerical integration, solutions to Fredholm integral equations) and evaluate the compatibility between numerical results and theoretical estimates.

Programme:

1. **Approximation theory.** Approximation of functions by means of algebraic and trigonometric polynomials. Lagrange interpolation and error estimates. Spline interpolation and error estimates.

2. **Numerical integration.** Interpolatory quadrature formula. Newton-Cotes formula. Orthogonal polynomials and Gauss quadrature formula. Product formulas. Error estimates. Extention to the bidimentional case.

3. **Integral equations.** Classification of integral equations. Fredholm integral equations of the second kind. Nyström method. Projection methods (collocation and Galerkin method).

References:

- Giuseppe Rodriguez, *Algoritmi Numerici*, Pitagora Editrice Bologna
- Giovanni Monegato, *Metodi e algoritmi per il calcolo numerico*, CLUT
- Rainer Kress, *Linear Integral Equations*, Springer
- Kendall E. Atkinson, *The Numerical Solution of Integral Equations of the Second Kind*, Cambridge University Press

Exam: Final report and oral interview