

Academic Year: (2023 / 2024)

Review date: 29-03-2023

Department assigned to the subject: Mathematics Department

Coordinating teacher: TERRAGNI , FILIPPO

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Partial Differential Equations.
Numerical Analysis.

OBJECTIVES**COMPETENCES and SKILLS**

- Acquiring theoretical knowledge that allows the student to develop original ideas, in a research context, knowing how to translate industrial needs into I+D+i projects in the Industrial Mathematics field.
- Being able to explain the results, along with the acquired knowledge, to experts and non-experts.
- Being able to get deeper into a subject in an autonomous way, which will be very useful to obtain a Ph.D.
- Being able to get quantitative and qualitative information from experimental data using numerical techniques.
- Knowing how to select the appropriate techniques to solve a specific problem.

DESCRIPTION OF CONTENTS: PROGRAMME

Introduction and Basic Notions

- Direct and inverse problems
- Well and ill-posed problems
- Existence and uniqueness of the solution
- Stability

Least Squares

- Motivation and general idea
- Applications

Regularization

- Motivation and general idea
- Tikhonov, Lardy and Landweber algorithms
- Morozov's discrepancy principle

Singular Value Decomposition

- Theoretical background, meaning and properties
- Noise filtering and data reconstruction
- Linear systems and regularization
- Extensions

Computed Axial Tomography

- Radon transform and sinogram
- Methods: back-projection and algebraic reconstruction

Topological Derivative

- Theoretical background
- Defects detection

- Methods: multifrequency and iterative
- Applications

LEARNING ACTIVITIES AND METHODOLOGY

Methodology:

- In-person classes.
- Homeworks and presentations.

Tutorials:

Students can ask questions via email and during the classes, or request an individual session.

ASSESSMENT SYSTEM

Criteria for both the 1st and 2nd assessment opportunities:

- A continuous evaluation system is planned, including the student's participation during the classes and homeworks. In addition, for all calls, students will have to deliver reports and make an oral presentation on practical problems related to the subject.
- In the case in which the student does not regularly attend the classes, professors will request additional exercises.

% end-of-term-examination:	0
% of continuous assessment (assignments, laboratory, practicals...):	100

BASIC BIBLIOGRAPHY

- A. Kirsch An Introduction to the Mathematical Theory of Inverse Problems, Springer-Verlag New York, 2011
- Frank Natterer, Frank Wübbeling Mathematical Methods in Image Reconstruction, SIAM, 2001
- J. Mueller, S. Siltanen Linear and Nonlinear Inverse Problems with Practical Applications, SIAM Computational Science and Engineering, 2012
- M. Bertero, P. Boccacci Introduction to Inverse Problems in Imaging, CRC Press, 1998