Advanced Methods in Applied Analysis

Academic Year: (2022 / 2023) **Review date: 12-05-2022**

Department assigned to the subject: Mathematics Department

Coordinating teacher: SECO FORSNACKE, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Algebra, Calculus (one and several variables), Differential Equations, Probability and Statistics, Numerical Calculus, and Programming in some language used in science and engineering.

OBJECTIVES

* To know the techniques and the ideas used in real and complex analysis, and its applications.
* To know the techniques used in measure theory.
* To know the elementary theory of real functional spaces.
* To understand the concept of approximation.
* To know the polynomial approximation with several norms: uniform, L2 and L1.
* To know the approximation and interpolation with splines.
* To understand la aproximación mediante funciones racionales, en particular los aproximantes de Padé.
* To understand the techniques involving the logarithmic potential and the capacity.

Basic competences
CB6, CB7, CB8, CB10
General competences
CG2, CG4, CG5, CG6, CG7
Specific competences
CE1, CE2, CE3, CE4, CE6, CE8, CE14

DESCRIPTION OF CONTENTS: PROGRAMME

1. Advanced Topics in Measure theory.
2. Best approximation in normed spaces. Existence and uniqueness.
3. Uniform approximation of continuous functions with algebraic polynomials.
4. Approximation with algebraic and trigonometric polynomials in L2.
5. Approximation with algebraic polynomials in L1.
6. Interpolation and approximation with splines. B-splines. Computation and applications.
7. Frame analysis.
8. Approximation with rational functions. Padé Approximants. Applications.

LEARNING ACTIVITIES AND METHODOLOGY

The docent methodology will include:

* Master classes, where the knowledge that the students must acquire will be presented. To make easier the development of the class, the students will have written notes and also will have the basic texts of reference that will facilitate their subsequent work.

* Resolution of exercises by the students, in which proposed problems are discussed and developed (by the professor and by the students). These classes allow to the students to acquire the necessary skills.

* Additionally, there will be tutorial learning activities. These tutorial activities will be supervised and they will have theoretical and practical content.
The rest of the working hours will be dedicated to the student's study. During this time the student can have access to the computer room.

ASSESSMENT SYSTEM

SE2: Individual or group work carried out during the course.
SE3: Final assessment.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- Ole Christensen, Khadija Laghrida Christensen Approximation theory: from Taylor polynomials to wavelets, Birkha¿user, 2006
- CHENEY, E.W., Introduction to Approximation Theory, Chelsea, 1982
- Cuyt, A., Wuytack, L., Nonlinear methods in Numerical Analysis, North Holland, 1982
- Davies, P.J., Interpolation and approximation, Dover, 1975
- Hammerlin, G., Hoffmann, K.H., Numerical Mathematics, Springer-Verlag, 1991
- Rudin, W. Real and complex analysis, McGraw Hill, 1987

ADDITIONAL BIBLIOGRAPHY

- RIVLIN, T.J., An Introduction to the Approximation of Functions, Dover, 1981
- Watson, G.A., Approximation theory and numerical methods, John Wiley and Sons, 1980