Advanced methods in orthogonal polynomials, complex analysis and applications

Academic Year: (2019 / 2020) **Review date: 26-04-2020**

Department assigned to the subject:

Coordinating teacher: MARCELLAN ESPAÑOL, FRANCISCO JOSE

Type: Electives ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The course Real and Complex Analysis of this master's program or, as a complementary background, Complex Analysis and Measure Theory in undergraduate courses

OBJECTIVES

Master the techniques and basic ideas in the study of orthogonal polynomials.
Master the applications of orthogonal polynomials.
Learn about different models of orthogonality.
Master the fundamentals of rational approximation.
Learn different models of rational approximation and its applications
Learn about the basic techniques and ideas used in the geometric theory of functions and its applications

DESCRIPTION OF CONTENTS: PROGRAMME

1- Orthogonal polynomials.
a) Standard orthogonality. Analytic properties of orthogonal polynomials on the real line. Zeros and asymptotic properties
of orthogonal polynomials. Spectral properties of differential operators and integrable systems.
b) Ortogonality with respect to a measure supported on the unit circle. Szegö's theory and its generalizations.
Applications in signal theory and linear prediction
c) Other models of orthogonality: Sobolev, matrix, multiple, multivariate.
2- Rational approximation.
a) Padé approximation. Applications.
b) Hermite-Padé approximation. Applications.
c) Fourier-Padé approximation. Applications.
3- Geométrica theory of functions.
a) Poincaré metrics and elementary properties.
b) Liouville type theorems.
c) Bounds on the increase of holomorphic functions. Applications.

LEARNING ACTIVITIES AND METHODOLOGY

Magister classes where the theory is presented (1.4 ECTS). The students will receive course notes on the sifferent subjects treated during the course and will have at their disposal reference textbooks to further deapen in the theory.

Another 1.4 ECTS will be dedicated to tutorized activity. Exercises, problems, presentation of part of the material by the students for the whole class.

The remaining 3.2 ECTS are or autonomous study of the material xposed in class as well as some complementaru topics.

ASSESSMENT SYSTEM

Oral expositions and solution of problems during the course (40%). Final oral or written exam (60%).

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- B. Simon Orthogonal Polynomials on the Unit Circle (2 volumes), Colloquium Publications American Mathematical Society vol 54, 2005
- E.M. Nikishin y V.N. Sorokin Rational approximation and orthogonality , Translations of Mathematical Monographs, AMS, 1991
- H. Stahl and V. Totik General Orthogonal Polynomials, Enc. of Math. and its Appl. 43, Cambridge Univ. Press, 1992

- J.L. Walsh Interpolation and Approximation by Rational Functions in the Complex Plane, Coll. Pub. AMS, vol 21, 1956
- J.L. Walsh Interpolation and Approximation by Rational Functions in the Complex Plane, Colloquium Publications American Mathematical Society, vol 21, 1956
- M. E. H. Ismail Classical and Quantum Orthogonal Polynomials in One Variable, Cambridge University Press, 2005

- T. Ransford Potential theory in the complex plane, Cambridge University Press, Student texts 28. London Math. Soc., 1995

ADDITIONAL BIBLIOGRAPHY

- F. Marcellan and Y. Quintana Polinomios ortogonales no estandar. Propiedades algebraicas y analiticas, Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela, 2009
- G. Lopez Constructive theory of functions, Coimbra Lecture Notes on orthogonal polynomials, Nova Science Pub. 2008, pp. 101-140, 2008
- G. Lopez and H. Pijeira Polinomios ortogonales, Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela., 2001