Hilbert spaces, wavelets and sampling theory

Academic Year: (2019 / 2020)   **Review date: 22-04-2020**

Department assigned to the subject:

Coordinating teacher: GARCIA GARCIA, ANTONIO

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 2

OBJECTIVES

1.- Knowledge of the main properties of Hilbert spaces.
2.- Using orthonormal bases, Riesz bases and frames in order to the stable recovery of elements in a Hilbert space.
3.- Knowledge of the main properties of Fourier transform.
4.- Introduction to Shannon's sampling theory.
5.- Reproducing kernel Hilbert spaces (RKHS)
5.- Introduction to wavelet theory.
6.- Construction of orthonormal bases of wavelets from a MRA.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- Basic properties of Hilbert spaces.
2.- Orthogonal projection theorem.
3.- Orthonormal bases. Fourier series.
4.- Riesz bases and Frames.
5.- Fourier transform.
6.- Shannon's sampling theorem.
7.- Reproducing kernel Hilbert spaces.
8.- Multiresolution analyses.
9.- Orthonormla bases of wavelets.
10.-Continuous wavelet transform.

LEARNING ACTIVITIES AND METHODOLOGY

The docent methodology includes:
- Master classes where the knowledge that the students should acquire will be presented. The students will have written notes and the basic references in order to make easier their subsequent work
- Problem classes where problems proposed to the students will be solved.
- Partial controls.
- Final control.

ASSESSMENT SYSTEM

Periodic controls: 40%
Final examination: 60%.

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

BASIC BIBLIOGRAPHY

- A. García García Bases en espacios de Hilbert: teoría de muestreo y wavelets, Sanz y Torres, 2014

- G. Bachman, L. Narici and E. Beckenstein Fourier and Wavelet Analysis, Springer, 2000

- G. G. Walter Wavelets and Other Orthogonal Systems with Applications, CRC Press, 1994

- M. W. Frazier An Introduction to Wavelets through Linear Algebra, Springer, 1999

- O. Christensen An Introduction to Frames and Riesz Bases, Birhauser, 2003

- P. Brémaud Mathematical principles of Signal Processing, Springer, 2002

- R. Young An Introduction to Nonharmonic Fourier Series, Academic Press, 2001

- S. Mallat A Wavelet Tour of signal Processing, Academic Press, 2009