ETSIT
Escuela Técnica Superior de
Ingenieros de Telecomunicación

Introduction to signal processing (ISP)			
Code number:	75105	Number of ECTS:	6 ECTS
Semester:	Spring	Language:	English

Lecturer(s) and contact:

- Dr. Tomasz Pieciak (tpieciak@tel.uva.es)

Learning goals:
At the end of the course, the student will be able to:

- Differentiate signal types and their representations.
- Analyze signals in time, frequency and time-frequency domains.
- Design low- and high-pass digital filters and filter a digital signal (i.e. electrocardiogram).
- Characterize the self-affinity of a biomedical signal.
- Implement own basic digital signal procedures.

Contents:

1. Introduction to signal processing, elementary algebra and mathematical analysis used in signal processing, continuous, discrete and digital signals.
2. Signal representations, sampling and quantization, aliasing.
3. Linear systems, convolution, correlation.
4. Continuous and discrete-time Fourier transform, discrete cosine transform, sliding DFT, coherence, short-time Fourier transform, Fast Fourier Transform (Cooley-Tukey algorithm).
5. Low- and high-pass filters, Finite and Infinite Impulse Response (FIR, IIR) filters design, filtering, parametric windows.
6. Detrended fluctuation analysis (DFA).

Laboratory classes:

1. Sinusoidal signal generation with specific parameters and noise distribution.
2. Implementing own DFT and sliding DFT procedures.
3. Implementing own low- and high-pass filter design procedures.
4. Implementing own linear convolution procedure, filtering electrocardiogram signal.
5. Implementing own short-time Fourier transform with an application to biomedical signals.
6. Implementing own FFT procedure (Cooley-Tukey algorithm).
7. Implementing own DFA procedure with an application to heart rate analysis.

Prerequisites:
Basic knowledge in algebra and mathematical analysis, basic programming skills in Python. Students bring their own laptops or work on workstations during the laboratory classes.

Assessment:
The grade is exclusively based on the written exam conducted at the end of the semester. The exam includes two parts: theoretical (50%) and practical part (50%). The theoretical part includes solving

calculus problems, while the practical one focuses on implementing signal processing procedures.