

## Course Specification Document

<b>Title</b>	Digital Signal Processing
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<b>Credits</b>	3.5 ECTS
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<b>Aims</b>	This course aims to provide the student with knowledge related to the characterization of digital signals in time and in frequency, their processing, the characterization of digital systems, and their properties, the design of digital filters with finite impulse response (FIR) and infinite impulse response (IIR), in addition to a short introduction to wavelets.
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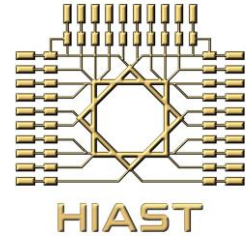
### Intended learning outcomes

On successful completion of this course, the student will be able to:

- Understand the concept of signal sampling and digitization.
- Understand digital systems, analyze them, and study their properties.
- Recognize the Fourier transform of a discrete signal, the discrete Fourier transform and its algorithms.
- Understand and study filters with finite impulse response FIR and infinite impulse response IIR.
- Use mathematical and physical methods to analyze digital systems.
- Design and implement finite impulse response filters FIR that meet real properties.
- Design and implement infinite impulse response IIR that meet real properties.
- Filter using circular convolution product and fast Fourier transform FFT algorithms.
- Implement discrete cosine transform and digital systems decomposition into all pass filter and minimum phase filter, and inverse filter design.

### Syllabus

- **Introduction to digital signals and systems:** Continuous signals and digital signals, digital systems and their properties: linearity, causality, stability, and time invariance, Fourier transform of a discrete signal, conditions of convergence of the Fourier transform of a discrete signal, Fourier transform of special sequences, properties of the Fourier transform of a digital signal.
- **Discrete Fourier transform and circular convolution:** Discrete Fourier transform of a discrete signal and Fourier series, properties of the discrete Fourier transform circular convolution product and its use in filtering.
- **Fast Fourier transform (FFT) and discrete cosine transform (DCT):** Methods of discrete cosine transform and its relationship to the Fourier transform, fast Fourier transform with time decomposition and frequency decomposition, analysis of linear phase systems, phase delay, and



group delay in linear systems, all pass and minimum phase systems, and analysis of systems using them.

- **Design of FIR filters:** Specifications of real filters, design using conventional windows, design using Caesar window, implementation of filters.
- **Design of filters with infinite response (IIR):** Design of analogue filters by Butterworth and Chebyshev, digital design using impulse response consistency method, digital design using a linear binary transformation method, implementing filters.
- **Introduction to wavelets:** Localization of signals in time and frequency, short-time Fourier transform and wavelet transform.