DIGITAL SIGNAL AND IMAGE PROCESSING

COURSE OUTLINE

Responsible: Georgios Giannakakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Electronic Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0806.4.003.0	**SEMESTER**	2nd
COURSE TITLE	Digital Signal and Image Processing		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	5
Total	**3**	**5**

COURSE TYPE general background, special background, specialised general knowledge, skills development	
PREREQUISITE COURSES	Signals and Systems
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Spring Semester
COURSE WEBSITE (URL)	

2. LEARNING OUTCOMES

Learning outcomes

The course aims to

- analyze discrete-time signals and systems using the Z-transform, the DFT and FFT algorithms
- design and implement FIR and IIR digital filters according to frequency-response specifications
- apply image enhancement techniques in the spatial and frequency domains
- select image restoration and compression methods appropriate to the requirements of the application
- implement signal and image processing algorithms in Matlab and document the results in a technical report

General Competences

Search for, analysis and synthesis of data and information, with the use of the necessary technologies

Decision-making

Autonomous work

Promotion of free, creative and inductive thinking

3. SYLLABUS

Discrete-time signals and the sampling theorem, fundamental principles of digital systems, linear convolution and linear difference equations. The Z-transform. Definition, properties. The inverse Z-transform. The discrete

Fourier transform. The fast Fourier transform and FFT algorithms. Implementation of digital filters. Basic filter types. Difference equations and digital filtering. Difference equations and the transfer function. Pole-zero diagram and stability. Frequency response of a digital filter.

Introduction to the theory of digital filters. Applications of discrete-time signals and systems. Analysis and design of digital filters. Digital filter structures, IIR filter design, FIR filter design.

Introduction to Digital Image Processing and applications. Basic concepts: elements of visual perception, light and the electromagnetic spectrum, image acquisition, sampling and quantisation, mathematical tools. Intensity transformations. Histogram processing. Filtering in the spatial domain, spatial smoothing and sharpening filters. Filtering in the frequency domain: sampling and the Fourier transform of sampled functions, the 2-D discrete Fourier transform and its properties, filtering in the frequency domain, smoothing and sharpening filters in the frequency domain. Image restoration: noise models, restoration in the presence of noise only, estimation of the degradation function, inverse filtering, Wiener filtering. Image compression: basic concepts and compression methods (lossy and lossless).

Use of computational packages for the design of filters.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Written exams and project
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	**Activity** | **Semester workload** **Course total** |
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	

5. ATTACHED BIBLIOGRAPHY

Greek or translated textbooks:

- Continuous- and Discrete-Time Signal Processing, Kafentzis Georgios, 2019
- Digital Signal Processing - Principles, Algorithms and Applications, Proakis J.G., Manolakis D., 2024
- Continuous- and Discrete-Time Signals and Systems with Matlab and Octave, 3rd Edition, Paraskevas Michalis, 2022.
- Digital Signal Processing, Veloni Anastasia, Myridakis Nikolaos, 2018
- Basic Techniques of Digital Signal Processing, 2nd Edition, Moustakides Georgios V., 2022
- Digital Signal Processing, 1st Revised Edition, Antoniou A, 2022
- Digital Image Processing, 4th Edition, Gonzales, Stefanos Kollias (ed.), 2018
- DIGITAL IMAGE PROCESSING AND ANALYSIS, PAPAMARKOS NIKOLAOS, 2013

Foreign-language textbooks:

- Li Tan, DigitalSignal Processing – Fundamentals and Applications, AacademicPress, Elsevier, 2008.
- Proakis J.G. & D.G. Manolakis, “Introduction to Digital Signal Processing”, MacMillan Publ., 1994.
- Chassaing R., “Digital Signal Processing Lab Experiments”, Wiley, 1999.
- IEEE Transactions on Image Processing