GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Digital Signal Processors, PG_00048091		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Metrology and Electronic Systems Department -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Janusz Smulko	
	Teachers	prof. dr hab. inż. Janusz Smulko	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 1056 Procesory sygnałowe
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1056

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	3.0	27.0	75

Subject objectives

Knows how to program digital signal processors and knows the selected digital signals algorithms and their implementation methods.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	136/5000 Acquires knowledge in the field construction and programming of systems digital for typical implementations digital algorithms signal processing.	[SW1] Assessment of factual knowledge
[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study	Familiar with the practical implementation of digital algorithms signal processing in selected set run with processor signal.	[SU1] Assessment of task fulfilment

Subject contents

Course content – lecture
1. Basic concepts of digital signal processing, presentation of the recommended literature.
2. Comparison of analog and digital techniques.
3. Rules for selecting digital signal processors (DSPs).
4. Characteristics of the DSP architecture and associated circuits.
5. Techniques for writing DSP control programs (file structure, interrupt handling).
6. Analysis of an exemplary DSP control program.
7. Functions of real-time operating system modules in DSP programming.
8. Parameters estimating DSP data processing speed.
9. Using MATLAB in preparing a DSP control program.
10. Numerical representations in DSPs - properties.
11. Detailed architecture of the functional blocks of selected DSPs from Analog Devices.
12. Basics of assembler for the 21xx family of DSPs (addressing modes, memory areas, interrupt handling).
13. DSP-compatible circuits, connection methods.
14. Features of Analog Devices SHARC processors.
15. Architecture of selected Texas Instruments DSPs.
16. Architecture and assembler of the Texas Instruments TMS320C5xxx family of DSPs.
17. Addressing methods, data paths, buffers, and caches in DSPs.
18. Optimization methods for DSP control code, pipelining mechanism.
19. FFT algorithm, flow graph, and graph implementation program.
20. Power spectral density estimation method.
21. Wavelet transform, Mallat algorithm.
22. Adaptive filtering in DSPs: sample program, implementation of digital filters.
23. Interrupt vector structure, interrupt handling stages.
24. Development prospects of DSPs, image analysis systems, and fast artificial intelligence calculations.

Course content – laboratory
1. Building and operating a DSP development starting kit.
2. Analyzing the file structure of the DSP control software project.
3. Analyzing an exemplary DSP control software project (handling interrupts from control buttons, display operations, modifying codec parameters).
4. Handling interrupts, implementing signal generation, digital filtering or selected acoustic effects, and operating the DMA channel.
5. Analyzing sample signals using the learned methods (determining power spectral density based on specified parameters).

Prerequisites and co-requisites

Introduction to digital signal processing

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory reports	60.0%	34.0%
Exam	50.0%	66.0%

Recommended reading

Basic literature	J. Smulko: Lecture materials available at his www site Lee, B. H., & Kuo, S. M. (2006). Real-Time Digital Signal Processing: Implementaions, Applications and Experiements with the TMS320C55X. Wiley. T. P. Zieliński: Cyfrowe przetwarzanie sygnałów. WKiŁ, Warszawa 2005. S.W. Smith: *The scientist and engineer's guide to digital signal processing*. 1997. R. Chassaing: Digital signal processing and applications with the C6713 and C6416 DSK. Wiley, 2005.
Supplementary literature	D. Stranneby: *Digital signal processing: DSP and applications*. Newnes, 2001.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Basic concepts of digital signal processing: the concept of digital signal, methods signal sampling, dynamics of digital techniques development, presentation of recommended literature 2. Characteristics of the basic elements of the structure of the digital signal processing system (filters anti-aliasing, A / C and C / A converters, signal processor) 3. Comparison of analog and digital techniques (programmability and repeatability of characteristics digital systems, the possibility of implementing adaptive algorithms) 4. Rules for selecting signal processors (DSP) 5. Characteristics of DSP architecture and cooperating systems 6. Techniques for writing DSP control programs (file structure) 7. Analysis of the sample DSP control program 8. Functions of DSP / BIOS modules in DSP programming 9. Parameters assessing the speed of data processing by DSP 10. The use of MATLAB in the process of preparing the program controlling the work of DSP (automatic program code generation tools) 11. Representation of fixed and floating point numbers in DSP - properties 12. Detailed architecture of functional blocks of Analog Devices signal processors, family 21xx 13. Assembler basics for DSP 21xx family (addressing modes, memory areas, interrupt handling, program structure) 14. Systems cooperating with DSP methods of connection 15. Architecture of Analog Devices SHARC processors 16. PS architecture of the TMS320C2xxx family from Texas Instruments 17. Adaptive filtration in the DSP sample program 18. Architecture and DSP assembly of the TMS320C5xxx family from Texas Instruments 19. Introduction to the DSP Architecture of the TMS320C6xxx family from Texas Instruments 20. Addressing methods, paths and data buffers in DSP of the TMS320C6xxx family from Texas Instruments 21. Assembler structure of the control word in DSP of the TMS320C6xxx family from Texas Instruments 22. Methods for optimizing the DSP control code 23. FFT algorithm; flow graph and graph program 24. The method of power spectral density estimation according to Welch 25. Wavelet transform, Mallat's algorithm 26. The future of DSP development
Practical activites within the subject	Not applicable

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