POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Signal processors and embedded systems [S2Eltech1E-MSSwE>PS1]

Course

Field of study	Year/Semester
Electrical Engineering	1/2
Area of study (specialization)	Profile of study
Microprocessor Control Systems in Electrical Engineering	general academic
Level of study	Course offered in
second-cycle	English
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other
15	15	0

Tutorials	Projects/seminars
0	15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge in the field of analog and digital electronics and the ability to design numerical algorithms and programming microprocessor systems at the level of first-cycle studies.

Course objective

Getting to know the architecture and applications of digital signal processors and embedded systems. Acquiring the ability to design real-time digital signal processing algorithms. Acquisition of programming skills for digital signal processors and microcontrollers with an ARM (Cortex) core - based on selected runtime environments.

Course-related learning outcomes

Knowledge:
1. Has in-depth, structured and theoretical knowledge in the field of analysis of electrical circuits; has advanced knowledge of discrete circuits and methods of synthesizing electrical double points.
2. Has extended knowledge of high-level programming with the use of object-oriented programming elements.

3. Has in-depth knowledge of the construction and design of complex electrical systems, in particular measurement and control systems, knows the basic processes occurring in the life cycle of technical systems.

Skills:
1. Is able design and manufacture electrical systems and systems for various applications.
2. Is able - when formulating and solving unusual engineering tasks and simple research problems - use a system approach, take into account non-technical aspects, use information and communication methods and tools.

Social competences:
Recognizes the importance of knowledge in solving cognitive and practical problems and understands that in technology, knowledge and skills quickly become obsolete and therefore require constant replenishment.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture.
The knowledge acquired during the lecture is verified by a 45-minute test, carried out during the last lecture. The test consists of 7-10 questions, with different scores. Passing threshold: 50% of points. The final issues, on the basis of which the questions are developed, will be placed on the eCursy platform.
Design
1. Continuous assessment, rewarding the increase in the ability to use the learned rules and methods.
2. Assessment of knowledge and skills related to the implementation of the project.
Laboratory
1. Continuous assessment, rewarding the increase in the ability to use the learned rules and methods.
2. Assessment of knowledge and skills related to the exercise, assessment of the exercise report.
Common methods for projects and laboratories.
Obtaining additional points for activity during classes, especially for:
- proposing to discuss additional aspects of the issue,
- the effectiveness of applying the acquired knowledge while solving a given problem,
- the ability to cooperate as part of a team practically carrying out a detailed task in the laboratory,
- remarks related to the improvement of teaching materials.

Programme content

The program content of the module is as follows:
1/ mathematical foundations of digital signal processing,
2/ HARVARD architecture of the microprocessor system (uP),
3/ architecture and instruction list of signal processors (DSP),
4/ features of embedded systems,
5/ DSP evaluation tools.

Course topics

Lecture topics include:
1/ presentation of structures and basics of designing digital filters,
2/ discussion of the basic features of the architecture and the instruction list of the SHARC(R) 1st generation Analog Devices processors,
3/ discussion of the basic features of the architecture of multi-core systems of the 5th generation SHARC(R) family from Analog Devices,
4/ discussion of the properties and use of DSP evaluation tools.

The topics of design classes include:
1/ presentation of the principles of designing FIR and IIR filters and the discrete Fourier transform,
2/ independent design of an IIR/FIR type filter by a student,
3/ discussion of completed projects.

Laboratory topics include:

1/ learning the practical use of DSP evaluation tools,
2/ getting acquainted with the properties and method of using the dedicated DSP evaluation system,
3/ implementation of the selected digital filtration algorithm.

Teaching methods

1. Lecture with a multimedia presentation (diagrams, formulas, definitions, etc.) supplemented with the content given on the blackboard.
2. Projects and laboratory exercises: multimedia presentation, presentation illustrated with examples given on the blackboard and carrying out the tasks given by the teacher - practical exercises.

Bibliography

Basic:
1. A. Dąbrowski, Przetwarzanie sygnałów przy użyciu procesorów sygnałowych, Wydawnictwo Politechniki Poznańskiej, Poznań, 2000.
2. R. G. Lyons, Wprowadzenie do cyfrowego przetwarzania sygnałów, Wyd. II, WKŁ, W-wa, 2010.
3. T.P. Zieliński, Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań, Wyd. II, WKŁ, W-wa, 2014.
4. S. R. Ball, "Embedded Microprocessor Systems: Real World Design", Elsevier Science, 2002.
5. Technical documentation of DSPs and controllers with ARM (Cortex) core and their application notes and educational materials - available on the websites of Analog Devices Inc. and STMicroelectronics.

Additional:
1. P. Barański, Przekształcenie Z. Zastosowania w filtracji cyfrowej sygnałów. Zbiór zadań., Wydawnictwo Politechniki Łódzkiej, 2014.
2. W. Kester, The Data Conversion Handbook, Elsevier, 2005.
3. An active power filter based on a hybrid converter topology – Part 1 / Michał Gwóźdź (WARiE), Łukasz Ciepliński (WARiE) // Bulletin of the Polish Academy of Sciences. Technical Sciences - 2021, vol. 69, no. 1, s. 1-10, URL: https://journals.pan.pl/dlibra/publication/136218/edition/119107/content
4. Application of a Tuned Inductor in a DC Power Supply with an Active Compensation Function / Łukasz Ciepliński (WARiE), Michał Gwóźdź (WARiE), Rafał M. Wojciechowski (WARiE) // Energies - 2022, vol. 15, iss. 17, s. 6108-1-6108-15, URL: https://www.mdpi.com/1996-1073/15/17/6108

Breakdown of average student's workload

	Hours	ECTS
Total workload	85	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50