



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Signal processors and embedded systems [S2Eltech2-MSSwE>PS2]

Course

Field of study

Electrical Engineering

Year/Semester

2/3

Area of study (specialization)

Microprocessor Control Systems in Electrical Engineering

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

0

Laboratory classes

0

Other

0

Tutorials

0

Projects/seminars

15

Number of credit points

1,00

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:

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.
3. 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

The topics covered in the project-based courses include:

The Fundamentals of Machine Learning and Its Practical Applications:

Part 1: Introduction to Deep Learning

Part 2: How to Train a Neural Network Using Microcontrollers with a GPU Module.

Part 3: Convolutional neural networks and how to apply them to mobile devices

Part 4: Scaling and deploying new data using digital cameras and microcontrollers

Part 5: Pre-trained models and their use for NVIDIA Jetson microcontrollers

Part 6: Advanced architectures

Teaching methods

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 Ciepłiński (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 Ciepłiński (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	30	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50