COURSE DESCRIPTION CARD - SYLLABUS

Course name
Acquisition and processing of measurement signals [N1Eltech2>PO4-RiPSP]

Course

Field of study
Electrical Engineering

Year/Semester
4/8

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
0

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Students should possess basic knowledge of metrology, electrical engineering, electronics, and computer science. They should also demonstrate the ability to effectively self-educate in a field related to their chosen field and demonstrate a willingness to collaborate within a team.

Course objective

Familiarization with the most important aspects of measurement data acquisition and processing. Obtaining key skills in the proper selection and use of signal acquisition and processing tools.

Course-related learning outcomes

Knowledge:
1. The student has knowledge of the structure and operation of signal acquisition systems.
2. The student has knowledge of basic signal processing methods.

Skills:
1. The student is able to select the appropriate measurement elements for the signal acquisition process.

2. The student is able to select and apply the appropriate method for processing a specific type of signal.

Social competences:
1. The student is aware that knowledge and skills in the field of electrical engineering are rapidly evolving.
2. The student is ready to utilize scientific achievements and consult with experts to effectively solve engineering problems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Assessment of knowledge and skills related to the completion of the final measurement task. Rewarding participation and verification of preparation for classes.

Programme content

Planning and implementation of tasks in the field of computer-aided measurement. Issues related to electrical signal acquisition. Configuration of measurement input blocks for signal acquisition. Issues related to basic methods of processing electrical signals in the time and frequency domains. Laboratory activities involve implementing selected signal acquisition and processing issues in a selected programming language. The emphasis is on exploring the possibilities offered by modern programming languages in signal processing, with the aim of better understanding the conceptual operation of individual methods and understanding their limitations (engineering approach). In general, laboratory activities cover content related to: signal sampling and aliasing; determining selected signal parameters; frequency-based signal analysis and the phenomenon of spectral leakage, which is related to frequency analysis; designing digital filters, including statistical filters; and correct analysis of signals in the discrete domain.

Course topics

L1. Occupational Health and Safety / Organization of laboratory activities. Introduction to a selected programming language.
L2. Introduction to signal sampling.
L3. Time-of-flight analysis of signals.
L4. Frequency-of-flight analysis of signals.
L5. Hazards associated with the use of the DFT algorithm.
L6. Estimation of the fundamental frequency of a signal.
L7. Issues related to signal filtration.
L8. Preparing a complete measurement chain for signal acquisition.
L9-L10. Acquisition of electrical signals.
L11-L13. Designing signal chains for a selected measurement task.
L14. Computer-aided measurement.
L15. Completion of the final measurement task to pass the laboratory.

Teaching methods

Performing laboratory exercises independently or in small teams (preparing the station, building measurement systems, performing experiments, implementing signal processing methods in the environment of a selected engineering support program, using ready-made signal processing tools) with the help and under the supervision of the instructor.

Bibliography

Basic:
Szabatin J., Przetwarzanie sygnałów, https://doc.lagout.org/dsp/J.Szabatin-PrzetwarzanieSygnalow.pdf ,2003.
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Marven C., Ewers G., A Simple Approach to Digital Signal Processing, John Wiley & Sons, 1996.
McKinney W., Python for data analysis, O'Reilly Media, 2013.

Additional:
Tretter S.A., Communication System Design Using DSP Algorithms, Springer, Boston 2008.
Madisetti V., The Digital Signal Processing Handbook, 2nd ed. Boca Raton, CRC Press, FL, USA 2009.
Downey A.B., Digital Signal Processing in Python, Green Tea Press, Needham, Massachusetts 2016.
Charbit M., Digital Signal Processing (DSP) with Python Programming, Wiley-ISTE, 2017.
Porr Bernd, Uniwersytet w Glasgow, Kurs projektowania filtrów z Pythonem: https://www.youtube.com/user/DSPcourse/playlists.
Kuwałek P., AM Modulation Signal Estimation Allowing Further Research on Sources of Voltage Fluctuations, IEEE Trans. on Industrial Electronics, vol. 67, no. 8, pp. 6937 6945, 2020.
Kuwałek P., Estimation of Parameters Associated with Individual Sources of Voltage Fluctuations, IEEE Trans. on Power Delivery, vol. 36, no. 1, pp. 351-361, 2021.
Kniat J., Programowanie obiektowe w C++. Wydawnictwo Politechniki Poznańskiej, Poznań 1999.
Lyons R.G., Wprowadzenie do cyfrowego przetwarzania sygnałów. Wydawnictwa Komunikacji i Łączności, Warszawa 1999.

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	20	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	35	1,50