COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced measurement techniques [S1MNT1>ZTP]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of mathematics, computer science, measurement systems. The ability to effectively self-educate, awareness of expanding one’s competences and being ready to work in a team. Ability to comply with the rules of the university study process.

Course objective

Learning advanced signal acquisition techniques in a multi-channel measurement system and digital processing of recorded data for signal analysis.

Course-related learning outcomes

Knowledge:
• the student has knowledge of engineering technologies used in digital signal processing systems and algorithms, the use of programming tools for data processing and analysis [K_W 04(P 6S_W G), K_W 05(P 6S_W G)];

• the student has knowledge of the operation of devices with digital signal processing and knows the rules of safe operation of these devices [K_W09(P6S_WG)].

Skills:
• the student is able to work independently and in a team, using knowledge in the field of engineering and technical sciences [K_U06(P6S_UW)];
• the student is able to set up a simple measurement track with a signal acquisition card for the purpose of recording and processing data, taking into account generally accepted principles of occupational health and safety [K_U09(P6S_UW), K_U11(P6S_UW)];
• the student is able to acquire the necessary knowledge to solve an engineering task, can evaluate the technical possibilities in order to carry out the task [K_U07(P6S_UW)].

Social competences:
• the student understands the need to acquire knowledge as well as raise and update their competences in the field of IT tools [K_K03(P6S_KO)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: assessment of the knowledge shown in the final test (test, accounting and problem questions, 50% pass threshold), rewarding activity in the classroom;
Laboratory classes: assessment of knowledge and skills related to the implementation of a laboratory task, assessment of the report made in class or at home. Rewarding insights regarding the improvement of the content of teaching materials;
Projects/seminars: assessment of knowledge, skills and activity in the implementation of the project task, evaluation of the study related to the implementation of the project task.

Programme content

Lectures: analog-to-digital signal processing, frequency analysis, modular devices with A/D converters, single- and multi-channel measurements of electrical and non-electric signals, signal filtering, non-invasive measurements of bioelectric signals;
Laboratories: acquisition of electrical signals, development of an application for signal recording with a DAQ card, recording to a file, signal filtration, measurements of non-electrical quantities, non-invasive measurements of bioelectric signals;
Projects/seminars: planning of a design task, feasibility analysis, development of project assumptions and work schedule, preparation of a report, conclusions.

Course topics

Lectures: analog-to-digital signal processing, sampling, quantization, interpretation of discrete-time signal samples, frequency analysis, spectrum leakage, modular devices with A/D converters, acquisition block, signal multiplexing, DAQ cards, creating a measurement task, single- and multi-channel measurements electrical signals, measurements of non-electrical quantities, adaptation of the signal path, signal filtering, non-invasive measurements of signals from the human skin surface, analysis and processing of bioelectric signals, filtering of discrete signals;
Laboratories: performing laboratory exercises, planning and implementing measurement tasks with DAQ cards, working with technical documentation of a measuring instrument, acquisition of electrical signals, creating an application for signal recording with a DAQ card, presentation and interpretation of signal samples, saving to a file, signal filtration, quantity measurements non-electric, non-invasive measurements of bioelectric signals from the human skin surface;
Projects/seminars: planning of a design task, feasibility analysis, review of solutions available on the market, development of design assumptions and work schedule, implementation of tasks, preparation of a report, conclusions.

Teaching methods

Lectures: lecture with a multimedia presentation supplemented with examples given on the blackboard, initiating discussions related to issues, referring to the curriculum content of other subjects;
Laboratory classes: individual or team work, discussion of various methods and aspects of problem solving. Detailed review of the documentation from the laboratory by the teacher;

Projects/seminars: work individually or in teams, discussing possible solutions and practical implementation of selected issues of the project task, reviewing the developed documentation.

Bibliography

Basic:
• Zieliński T., Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań, WKŁ, Warszawa 2014;
• Lyons R. G., Wprowadzenie do cyfrowego przetwarzania sygnałów, tł. z jęz. ang. Zarzycki J., Jerzy Szymbor J., WKŁ, Warszawa 2010;
• ŚwisulskiD. ,Przykłady cyfrowego przetwarzania sygnałów w LabVIEW, Wydawnictwo Politechniki Gdańskiej, 2012;
• Winiecki W., Organizacja komputerowych systemów pomiarowych, Oficyna Wydawnicza Politechniki Warszawskiej, 2006.

Additional:
• Gajo Z., Podstawy cyfrowego przetwarzania sygnałów, Oficyna Wydawnicza Politechniki Warszawskiej, 2019;
• Moczko J. A., Kramer L., Cyfrowe metody przetwarzania sygnałów biomedycznych : zadania Wydawnictwo Naukowe UAM, 2001;
• Lesiak P., D. Swisulski D., Komputerowa technika pomiarowa w przykładach, Agenda Wydawnicza PAK, 2002;
• Bishop R. H., LabVIEW student edition, National Instruments, Prentice Hall 2015;
• Krawiecki Z, Szałkiewicz S., Hulewicz A., Identyfikacja artefaktów EKG zarejestrowanych podczas monitorowania sygnału EMG, Poznan University of Technology Academic Journals. Electrical Engineering - 2017, Issue 89, s. 229-238;
• Krawiecki Z., Hulewicz A., Dziarski K., The measurement stand with DAQ card for recording a bioelectric signal from human muscles, ITM Web of Conferences - 2019, vol. 28, s. 01042-1-01042-2.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00