



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Signal processing in measurements and power system protection [N2Eltech2-SiAE>PSwP]

### Course

Field of study

Electrical Engineering

Year/Semester

2/3

Area of study (specialization)

Power Networks and Electric Power Systems Protection

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

part-time

Requirements

compulsory

### Number of hours

Lecture

10

Laboratory classes

10

Other

0

Tutorials

0

Projects/seminars

0

### Number of credit points

2,00

### Coordinators

dr inż. Andrzej Kwapisz

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### Lecturers

### Prerequisites

Student has knowledge in the field of power engineering, power system protection and decision algorithms in power engineering.

### Course objective

The aim of the course is to learn the methods of signal processing and the synthesis of measurement and decision algorithms in measurement lines of power system protection.

### Course-related learning outcomes

Knowledge:

1. Student has expanded knowledge of advanced numerical methods used in issues related to the design of power system protection.
2. Student has expanded knowledge of creating decision algorithms and methods for optimizing the work of power system protection used in power engineering.
3. Student has in-depth theoretical and practical knowledge in the field of interference states and their sources in the power grid. He has knowledge of how to limit the effects of network interference such as

phase-to-phase and earth faults.

4. Student knows the general principles of creating and developing forms of individual entrepreneurship as well as protecting industrial property and copyright.

Skills:

1. Student is able to assess and compare the design solutions of power system protection due to the given utility and economic criteria.
2. Student can plan the testing process of power system protection layout.

Social competences:

1. Student is aware of developing professional achievements and compliance with the principles of professional ethics, fulfilling social obligations, inspiring and organizing activities for the social environment.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture

Written test at the end of the semester, the test includes test questions or problem tasks related to the topic of classes conducted within the subject, assessed on a scale from 0 to 100%, additionally rewarded for activity in classes and completed homework. Final grade for lectures conducted by more than one lecturer on the basis of the weighted average, final grade for more than one component grade on the basis of the weighted average. Passing threshold of 60%.

Laboratory

Verification of individual preparation for classes and involvement in the exercise, assessment of individual exercise reports made by the student, all grades on a scale from 0 to 100%, final grade based on the weighted average of all component grades. Passing threshold of 60%.

### Programme content

Signal filtering in control and measurement systems.

Advanced methods of digital data processing in power automation protection systems.

### Course topics

Lecture

Signal processing path in power protection automatics systems, analog signal processing. Selected methods of analysis of measurement signals and identification of disturbances. Analog-to-digital conversion. Analogue filtration, anti-aliasing filtration. Digital filtration, synthesis of recursive and non-recursive filters. Measurement algorithms of basic criterion quantities. Logical structures of power protection circuits.

Laboratory

Designing analog filters using simulation methods, implementation of analog filters. Design of digital filters, synthesis of recursive and non-recursive digital filters. Implementation of the measurement path and decision-making system for power protection automation systems.

### Teaching methods

Lecture

Multimedia and interactive presentation presenting important issues related to the subject, didactic discussion based on the literature on the subject, informative lecture, problem lecture, case analysis, work on source materials.

Laboratory

A multimedia presentation introducing you to work independently with signal processing programs, creating filters for signal analysis in software prepared for this purpose.

### Bibliography

Basic:

1. Musierowicz K., Staszak B.: Technologie informatyczne, cz. I - przetwarzanie sygnałów, Wyd. PP, Poznań, 2010.

2. Szafran J., Wisznieski A.: Algorytmy pomiarowe i decyzyjne cyfrowej automatyki elektroenergetycznej, WNT, Warszawa, 2001.

Additional:

1. Wiszniewski A.: Algorytmy pomiarów cyfrowych w automatyce elektroenergetycznej, WNT, Warszawa, 1990.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	20	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00