# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Information technologies in electrical power engineering [S1Eltech2>TIwE]

## Course

Field of study
Electrical Engineering

Year/Semester
3/5

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
0

## Number of credit points

2,00

## Coordinators

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## Lecturers

## Prerequisites

Basic knowledge of mathematics, physics, and electrical engineering. Knowledge of programming languages and CAS systems. Basic concepts of electrical networks and power systems. Knowledge of measurement methods and systems.

## Course objective

The aim of the course is to familiarize students with data processing and visualization methods in the context of electrical power engineering. The course aims to develop skills in analyzing data from electrical power systems, as well as teaching how to effectively present the results of analysis in visual form, which is crucial in the management and monitoring of energy systems.

## Course-related learning outcomes

Knowledge:
The student knows and understands methods of data processing and analysis in the context of electrical power engineering.
The student has knowledge of data visualization techniques used in the analysis of electrical power systems.

The student understands the principles of operation of electrical power systems and the challenges associated with the analysis of large data sets from these systems.
The student knows the basic tools and technologies used in data analysis and visualization.

Skills:
The student is able to independently analyze data from electrical power systems using computer tools.
The student is able to present the results of data analysis in a visual form, in accordance with the requirements of engineering practice.
The student is able to develop data processing and visualization algorithms, taking into account the specific nature of power engineering data.
The student is able to perform load forecasts and analyze real-time data from power grids.

Social competences:
The student is able to work in a team, carrying out joint projects related to the analysis of electrical energy data.
The student shows initiative in searching for modern solutions in the field of data processing and visualization.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture
A written final exam at the end of the semester, the exam includes test questions or problem-solving tasks related to the subject matter covered in the course, graded on a scale of 0 to 100%. Class participation and completed homework assignments account for 15% of the final grade. The final grade for lectures taught by more than one lecturer is based on a weighted average, and the final grade for more than one component is based on a weighted average.
Laboratory
Verification of individual preparation for classes and involvement in the exercise, assessment of individual exercise reports completed independently by the student, all assessments on a scale of 0 to 100%, final assessment based on a weighted average of all component assessments.

## Programme content

Lecture
Introduction to data processing in electrical power engineering. Sources and structure of measurement data. Measurement data processing, time series analysis. Data analysis and visualization. Interactive data visualization tools. 3D visualization and GIS systems. Methods of presenting and compiling measurement results.
Laboratory
Working with real data: loading, cleaning, and analyzing data from power systems. Processing measurement data. Using tools for data analysis and visualization. Analyzing data from real power systems using statistical methods and algorithms to estimate the state of the power system.

## Course topics

Lecture
Data in electrical power engineering - characteristics and challenges. Measurement systems: SCADA, Smart Metering. Data processing and filtering methods. Data exchange formats. Descriptive statistics and correlation analysis in energy data. Data visualization methods - theory and practice. Programming tools for data analysis. Load and generation profile analysis. Anomaly detection in electrical energy data. Presentation of results and report creation. Examples of data analytics applications in the energy sector.
Laboratory
Import and pre-processing of measurement data. Data cleaning and completion algorithms (data gaps, data fitting). Processing large data sets. Determination of basic electrical signal parameters. Time series analysis. Signal filtering. 2D/3D visualizations and animations. Use of programming libraries in calculations (e.g., Python, Julia, Matplotlib).

## Teaching methods

Lecture

Multimedia and interactive presentation of relevant topics related to the subject, didactic discussion based on the subject literature, informative lecture, problem-based lecture, case study, work on source materials
Laboratory
Laboratory exercises based on real or simulated data. Exercises using programming tools.

## Bibliography

Basic:
J. Machowski, Zarządzanie i analiza danych w elektroenergetyce, PWN, 2016
A. KKhanna, Data Analytics for Smart Grids. CRC Press, 2019
Wes McKinney, Python for Data Analysis, O'Reilly Media, 2018

Additional:
L. M. O'Neill, Advanced Data Visualization for Energy Systems,Elsevier, 2022
T. J. Harwood, Python for Data Analysis in Power Systems, O'Reilly Media, 2021
Dokumentacje narzędzi: Scilab, Orange, Pandas, NumPy, Matplotlib, Plotly, SciPy.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 55 | 2,00 |
| Classes requiring direct contact with the teacher | 30 | 1,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 25 | 1,00 |