COURSE DESCRIPTION CARD - SYLLABUS

Course name
Statistical process control [S2Eltech2>SSP]

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
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

The student starting this course should have basic knowledge in the field of mathematics, statistics and programming basics, as well as the ability to work in a laboratory group.

Course objective

Expanding student's knowledge in the field of analysis and presentation of measurement data. Acquiring practical skills to use the methods of descriptive statistics and methods of statistical process control, and acquiring the ability to apply the knowledge of the analysis and presentation of data in the technical fields.

Course-related learning outcomes

Knowledge:
1. Student has knowledge of statistics and its relations with technical sciences.
2. Student has knowledge of descriptive statistics, which allows for the analysis of phenomena in the field of electrical engineering.
3. Student has knowledge of statistical process control.
4. Student has knowledge of the analysis and presentation of measurement data.

Skills:
1. Student is able to formulate the aim, subject and scope of the statistical analysis of the obtained measurement data.
2. Student is able to present the results of a statistical survey.
3. Student is able to choose the appropriate statistical tools for the analysis of a specific problem.
4. Student is able to perform quantitative analyzes and on this basis formulate qualitative conclusions regarding the studied phenomenon.
5. Student is able to carry out a statistical control of the technological process.

Social competences:
1. Student understands the need for further education and development of acquired skills.
2. Student understands the social aspects of the practical application of the acquired knowledge and the related responsibility.
3. Student understands the needs of entrepreneurial activity.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

To complete the course, it is necessary to complete the control tasks (components of the project) with the use of the tools learned in class. During the implementation of tasks, emphasis is placed on verifying experimentally the operation and limitations of selected methods for data analysis and visualization. Models or real data from the field of electrical engineering will be used. The ability to correctly interpret the results of the applied statistical analysis is taken into account in the evaluation.

Programme content

The program content covers two main areas, i.e.:
- statistical analysis of time series;
- statistical process control.

In the case of statistical analysis of time series, issues are covered in the following areas:
- data analysis and visualization;
- selected issues of descriptive statistics, including parametric and nonparametric statistics;
- statistical tests;
- methods of analysis and processing of time series, including determining trends, determining cyclical and seasonal fluctuations, data smoothing.

In the case of statistical process control, issues are covered in the following areas:
- process variability;
- tools supporting process quality management;
- statistical techniques and methods related to current normative requirements in the field of statistical process control.

The program content is implemented using a selected programming language.

Course topics

P1: Introduction. Presentation of the problems (necessity) of data analysis and visualization on examples. Introduction to Matlab/Python.
P2: Descriptive statistics: tabular description (e.g. distribution series), parametric statistics: distribution measures (e.g. position measures, differentiation measures, asymmetry measures, concentration measures), non-parametric statistics: graphical representation of results (e.g. histogram, kernel density estimation, box plot, Pareto diagram).
P3: Statistical distributions. Central Limit Theorem. The rule of three sigmas. Statistical tests, including distribution tests.
P4-P5: Statistical process control (SPC): process variability, descriptive and dispersion statistics, tools supporting quality management (e.g. Pareto diagram, histograms), techniques and statistical methods for the purposes of ISO 9001 based on ISO TC 176 (standard ISO 10017).
P6: Time series analysis and processing methods. Setting trends. Time series frequency analysis.

Correlation analysis. Data smoothing.
P7: The problem of automatic processing of big data sets (Big Data). Selected basic topics of machine learning methods, mainly methods based on unsupervised learning. The problem of data clustering and searching for cluster analysis (searching for similarities, common features).

Teaching methods

Implementation of design tasks independently or in small teams with the help and supervision of the teacher. The content presented on the course is focus on intuitive understanding ideas and limitations of individual methods of statistical analysis and data visualization methods.

Bibliography

Basic:
- E. Wasilewska, Statystyka matematyczna w praktyce. Wydawnictwo Difin, 2015.
- I. Bąk, I. Markowicz, M. Mojsiewicz, K. Wawrzyniak, Statystyka opisowa : przykłady i zadania.Wydawnictwo: CeDeWu, Warszawa 2015.
- W. Starzyńska, Statystyka praktyczna. Wydawnictwo Naukowe PWN, Warszawa 2012.
- M. Iwińska, B. Popowska, M. Szymkowiak, Statystyka opisowa. Wydawnictwo Politechniki Poznańskiej, 2011.
- J. Buga, H. Kassyk-Rokicka, Podstawy statystyki opisowej. Wydawnictwo: Vizja Press & IT, Warszawa 2008.
- Sałaciński T.: SPC statystyczne sterowanie procesami produkcji. Oficyna Wydawnicza Politechniki Warszawskiej 2009 r.
- Hamrol A., Zarządzanie jakością z przykładami, PWN 2008.

Additional:
- Smith G. M., Statistical Process Control and Quality Improvement, Pearson Prentice Hall 2004.
- A. Witkowska, M. Witkowski, Statystyka opisowa w przykładach i zadaniach. Wydawnictwo Uczelni Państwowej Wyższej Szkoły Zawodowej im. Prezydenta Wojciechowskiego, Kalisz 2007.
- Kuwałek P., Trace of Flicker Sources by Using Non-Parametric Statistical Analysis of Voltage Changes, Proc. of the 19th Int. Conf. on Harmonics and Quality of Power, IEEE, pp. 1-6, 2020, ZEA, Dubaj.Tretter S.A., Communication System Design Using DSP Algorithms, Springer, Boston 2008.

Breakdown of average student's workload

	Hours	ECTS
Total workload	27	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)	12	0,50