



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Control and automation in electric power system [S2Elenerg1>SiA]

### Course

Field of study

Electrical Power Engineering

Year/Semester

1/1

Area of study (specialization)

Electric Energy Exploitation

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

30

Laboratory classes

30

Other

0

Tutorials

0

Projects/seminars

15

### Number of credit points

5,00

### Coordinators

dr inż. Bartosz Olejnik

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### Lecturers

### Prerequisites

The student has knowledge of the basics of electrical engineering, power engineering, electrical metrology and computer science. Knows issues related to the transmission and distribution of electricity. The student has knowledge in the field of modern current and voltage measuring systems and the ability of switchgear in power networks. Knows the basic solutions of electrical power protection automation. Is able to carry out the analysis of electrical circuits and occurring in short-circuit interference networks.

### Course objective

Understanding the threats to the proper operation of the power system. Understanding how to counteract these threats and the regulatory capacity of the system. Getting to know the automation solutions and functions improving the working conditions of the power system.

### Course-related learning outcomes

Knowledge:

he has knowledge in the field of power system control and the use of power system protection. he can use the available ict technologies.

## Skills:

he can use numerical methods and its tools to design and analyze the operation of power protection automation systems. he can cooperate with other people as part of team work on solving an engineering problem, as well as take managerial functions in these teams.

## Social competences:

correctly identifies and resolves dilemmas related to broadly understood energy security. can think and work creatively and enterprisingly. understands the need for actions to make the society aware of the development of the power industry, but also to reduce the risks it carries.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture:

1. Rewarding activity during classes in the form of a discussion.
2. Assessment of knowledge and skills demonstrated in the written exam.

Laboratories:

1. Checking theoretical knowledge related to the performed exercises.
2. Rewarding activity during the exercise.
3. Assessment of the reports from the exercises carried out.

Projects:

1. Assessment of activity during project implementation
2. Evaluation of the completed project

## Programme content

The structure of the power system. Voltage and frequency regulation in power system. System automation. Neutral point earthing methods in power grid. Zero-sequence impedance regulation in earth-fault circuits. Active power transmission control. Power system stability.

## Course topics

The structure of the power system, introduction, concepts and definitions. Basics of optimization of steady states of the power system. Voltage regulation in the power system and voltage stability (local, global). Power system frequency regulation and SCADA automation. Selected issues of control and protection automation in distribution and transmission networks (ARN, SPZ, SZR systems, ground fault tracking compensation, connection synchronization systems in networks). Power system protection (PSP) for power units. Active power transmission control (phase shifters, power electronic couplings). Power swings in the power system and loss of synchronism and anti-swing automation. Controlling the network operation during defense against a catastrophic failure and after it. Laboratories\_ Laboratory tests in the field of\_ short-circuit phenomena in power grids, PSP systems, the use of the DAKAR program in the implementation of control and automation systems in the power system. Projects\_ Designing selected automation and control systems in power systems\_

## Teaching methods

Lecture: Multimedia presentations. Problem discussions

Laboratories:

Classes at didactic positions with the use of measuring apparatus for physical models of elements of the power system. Part of laboratory classes at computer workstations with the use of various simulation environments. Group working.

Projects:

Regular group and individual consultations with the support of catalogs, project documentation and devices. Theory presented in close connection with practice.

## Bibliography

Basic

Jan Machowski: Regulacja i stabilność systemu elektroenergetycznego. OW Politechnik Warszawskiej, Warszawa 2017

- W.Winkler, A. Wiśniewskii: Automatyka zabezpieczeniowa w systemach elektroenergetycznych. WNT, Warszawa 1999
- Józef Żydanowicz: Elektroenergetyczna automatyka zabezpieczeniowa. tom III. WNT, Warszawa 1987
- Additional
- W. Korniluk, K. Woliński: Elektroenergetyczna automatyka zabezpieczeniowa. OW Politechniki Białostockiej, wyd. III, Białystok 2012
- J. Wróblewski: Zespoły elektroenergetycznej automatyki zabezpieczeniowej. WNT, Warszawa 1999
- Praca zespołowa pod redakcją Andrzeja Demenki i Józefa Lorenca: Blackout a krajowy system elektroenergetyczny. Ośrodek Wyd. Naukowych ICHB PAN, Poznań 2014, Poznań 2016, Poznań 2018
- Witold Hoppel: Sieci średnich napięć. PWN, Warszawa 2013
- E. Rosołowski: Komputerowe metody analizy elektroenergetycznych stanów przejściowych. OW Politechniki Wrocławskiej, Wrocław 2019
- J. Andruszkiewicz, J. Lorenc, B. Staszak: Wspomaganie bezpieczeństwa pracy sieci dystrybucyjnych SN przez program doboru nastaw zabezpieczeń ziemnozwarciowych. W: Cyberbezpieczeństwo i bezpieczeństwo fizyczne obiektów w energetyce - wybrane aspekty badawcze (red. Robert Maciejewski). Fundacja na Rzecz Czystej Energii, Poznań, 2018, str. 178-191.
- J. Andruszkiewicz, J. Lorenc, B. Staszak: Kompensacja nadążna pojemnościowych prądów ziemnozwarciowych w sieciach SN. Wiadomości Elektrotechniczne, nr 12, 2016, s. 37-42.
- J. Handke, B. Olejnik, A. Schott: Algorytmy samoczynnego częstotliwościowego odciążania w świetle obowiązujących rozporządzeń Komisji Europejskiej. Przegląd Elektrotechniczny, R. 95, nr 2, 2019, s. 7-10.
- I. Grządzielski, B. Olejnik, M. Zakrzewski: Modeling of transient states in the start-up path during voltage and start-up power application. Archives of Electrical Engineering, vol. 68, no. 4, 2019, s. 749-769.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00