



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Smart distribution grids [S2Elmob1-PAiME>ISR]

### Course

Field of study

Electromobility

Year/Semester

2/3

Area of study (specialization)

Alternative Fuels and Energy Storage

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

0

Other

0

Tutorials

0

Projects/seminars

0

### Number of credit points

2,00

### Coordinators

dr inż. Krzysztof Łowczowski

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### Lecturers

### Prerequisites

Fundamental knowledge in electrical power engineering - short-circuit calculations, calculations of power flows, etc. Knowledge about the elements of a traditional power grid and knowledge about principles of operation of power grids. Knowledge about basic control systems and protection relays.

### Course objective

Knowledge about principles of operation of smart grids, in particular advanced knowledge about local energy sources, regulation devices and modern loads - electric cars, energy storage systems. Ability to perform advanced short-circuit calculations in networks containing active elements. Ability to use power system optimization tools, e.g. optimization of power flows or estimation of electrical quantities. Knowledge about selected, advanced protection relay functions and control systems in the distribution 2 network. Knowledge of measurement systems used in distribution networks. The ability to identify and solve problems with power quality and disturbances. Basics of network development planning and automation construction.

### Course-related learning outcomes

Knowledge:

The student has a well-established knowledge of the construction of power grids, the phenomena occurring in them, operating states and methods of analyzing conventional and intelligent networks, including distributed generation and other active elements.  
The student has knowledge of the elements of the power system and power system operation control, as well as the methods of using protection automation and ICT technologies to protect the power grid and devices.

#### Skills:

The student is able to use modern IT tools and numerical methods to design and analyze the operation of power systems and protection automation.

#### Social competences:

The student is aware of the problems related to energy security. The student is able to creatively solve problems related to power systems, taking into account economic issues and broadly understood entrepreneurship. The student understands the need to make the society aware of the development of modern power engineering and the dangers of development

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

#### Lecture

- assessment of knowledge and skills shown in the written test; the colloquium consists of test and open-ended questions with different scores; pass mark 50% of points;
- continuous assessment in each class (rewarding activity);

### Programme content

Cooperation of energy sources and storage facilities with the distribution network, including control systems and protection automation. Network development planning.

### Course topics

#### Lecture

Presentation of storage parameters important for power networks. Discussion of problems resulting from connecting local energy sources and storage facilities, taking into account disturbance states. VRT automation overview. Presentation of the method of planning the development of the power system

#### Lab

Examples and tasks related to lectures

#### Design

Selected issues related to current issues of power networks, e.g. integration devices connected to the power grid or designing network control systems  
electricity

### Teaching methods

Lecture: multimedia presentation, illustrated with examples given on the board and examples of computer simulations and other tools to support the operation of the power system

### Bibliography

#### Basic:

1. Jan Machowski, Regulacja systemu elektroenergetycznego, Warszawa 2017
2. J. Machowski, Z. Lubośny, Stabilność systemu elektroenergetycznego, WNT 2018
3. A. Kanicki, Systemy Elektroenergetyczne

#### Additional:

Nicolaie Fantana, Krzysztof Lowczowski, Radek Javora i inni, Substation servicing and supervision using mobile devices and smart sensing, CIGRE, grudzień 2020

### 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