# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Overvoltage protection in the electrical power system [S2Elenerg1-ISD>OP]

## Course

Field of study
Electrical Power Engineering

Year/Semester
1/1

Area of study (specialization)
Smart Grids

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
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

## Number of credit points

2,00

## Coordinators

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## Lecturers

dr hab. inż. Krzysztof Walczak prof. PP
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## Prerequisites

The student has a basic knowledge of electrical engineering, power engineering and metrology. Can set up a measuring system; can carry out measurements of basic physical quantities and process the results of these measurements. Can work in a group and understands the importance of teamwork.

## Course objective

Getting to know theoretical and practical problems related to the occurrence of overvoltages in power networks. Understanding the causes and effects of overvoltages and methods of limiting them in electric power systems. Getting to know the standards of procedure in accordance with the principles of overvoltage and lightning protection and insulation coordination of the power system in conditions of overvoltage disturbances. Getting to know the principles of selection of lightning and surge protection elements.

## Course-related learning outcomes

Knowledge:
has knowledge of the generation of overvoltage phenomena in power networks, both internal and external. he knows what measures use to limit the effects of overvoltages. he knows the issue of

electric strength of insulation systems and their coordination in high voltage transmission systems in order to ensure their reliability.

Skills:
can properly select overvoltage and lightning protection measures in order to ensure reliable operation of power equipment in conditions of overvoltage disturbances.
he can apply his knowledge to properly coordinate the insulation systems of power devices to ensure their reliability in conditions of overvoltage disturbances.
can cooperate with other people as part of team work on solving an engineering problem in the field of analysis and protection of electrical power devices against the effects of surges.

Social competences:
the student is aware of the need to disseminate knowledge on the risk of electric shock as a result of a disruption or failure of the power system components due to overvoltage phenomena.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lectures:
Assessment of knowledge and skills demonstrated in a written exam of a descriptive/problem/test nature. Assessment of answers to questions according to the point system, 50% of the maximum number of points required. Exam questions, on the basis of which questions for the exam are formulated, are sent to the staroste and briefly discussed during the last lecture.
Laboratory classes:
Test the knowledge before performing the exercise in the form of a test and evaluate the reports. In order to obtain credit, it is necessary to pass all tests and to obtain positive assessments from the reports prepared as a team.

## Programme content

Lectures:
The lectures cover the following topics: classification and overvoltage statistics; surge waves in lines: wave reflections in nodes, multiple reflections, attenuation, waves in multi-line systems; surge waves in windings of transformers and machines; atmospheric overvoltages; internal overvoltages: dynamic, resonant, earth-fault and switching; devices for protection against overvoltage: spark gaps, surge arresters, lightning leads and lightning conductors; traditional and statistical concept of insulation coordination; overvoltage protection rules for lines and stations; protection of building structures, rules for creating grounding installations; protection of renewable energy installations (wind, photovoltaic).
Laboratory classes:
Laboratory classes concern: measurement and assessment of overvoltage levels in the power system, methods of reducing the impact of overvoltages on the power grid.

## Teaching methods

Lectures:
Multimedia presentation complemented by examples given on the board. Take into account the various aspects of the presented issues, including economic, environmental and social issues. Introducing a new topic is preceded by a reminder of related content, which are known to students from previous lectures and other subjects.
Laboratory classes:
Solving sample tasks by a presenter with active participation of students, self-solving tasks by students. Examples of electromagnetic compatibility.

## Bibliography

Basic
1. Flisowski Z., Technika wysokich napięć, WNT, Warszawa, 2005.
2. Duda D., Gacek Z., Przepięcia w sieciach elektroenergetycznych i ochrona przed przepięciami, Wydawnictwo Politechniki Śląskiej, Gliwice 2015.
3. Hasse P., Wiesinger J., Ochrona aparatury elektrycznej przed wyładowaniami atmosferycznymi.

Analiza ryzyka, projektowanie i wykonanie według najnowszych norm., Centralny Ośrodek Szkolenia i Wydawnictw SEP, Warszawa 2004.
4. Markowska R., Sowa A.W., Ochrona odgromowa obiektów budowlanych, Dom Wydawniczy MEDIUM, Warszawa 2009.
5. Norma PN-EN 62305, Ochrona odgromowa, Arkusz 1-4, Polski Komitet Normalizacyjny, Warszawa 2006
Additional
1. Alain Charoy, Kompatybilność elektromagnetyczna. Zakłócenia w urządzeniach elektronicznych, Tomy od I do IV, Wydawnictwa Naukowo-Techniczne, Warszawa, 2000
2. Analysis of Overvoltages Appearing in One-Sidedly Ungrounded MV Power Cable Screen, Schött-Szymczak A., Walczak K., Energies - 2020, vol. 13, no. 7, s. 1821-1-1821-14
3. Ochrona przed wewnętrznymi przepięciami w sieciach SN – podstawy teoretyczne, Walczak K., Zawodniak J.J., Automatyka, Elektryka, Zakłócenia - 2019, vol. 10, nr 3 (37), s. 36-45

## 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 |