

DESCRIPTION OF THE COURSES

- Course code: **ELR2264**
- Course title: **DISTURBANCES IN POWER SYSTEMS**
- Language of the lecturer: **Polish**

<i>Course form</i>	<i>Lecture</i>	<i>Classes</i>	<i>Laboratory</i>	<i>Project</i>	<i>Seminar</i>
<i>Number of hours/week*</i>	2	1			
<i>Number of hours/semester*</i>	22	11			
<i>Form of the course completion</i>	pass	completion			
<i>ECTS credits</i>	2	1			
<i>Total Student's Workload</i>	60	30			

- Level of the course (basic/advanced): **advanced**
- Prerequisites: **Theory of Electrical Circuits, High Voltage Engineering, Electrical Power Systems, Disturbances in Industrial Devices and Distribution Networks**
- Name, first name and degree of the lecturer/supervisor: **Janusz Fleszyński, prof. dr hab. inż., Wilhelm Rojewski, dr inż..**
- Names, first names and degrees of the team's members: **Janina Pospieszna, dr hab. inż., Maciej Jaroszewski, dr inż., Krzysztof Wieczorek, dr inż.**
- Year:.....I/II degree..... Semester:.....1.....
- Type of the course (obligatory/optional): **obligatory**
- Aims of the course (effects of the course): **Understanding the reasons and consequences of transients in power systems. Knowing of the protection against them.**
- Form of the teaching (traditional/e-learning): **traditional**
- Course description:

Classification of transient states and electromagnetic disturbances in electrical power systems. External and internal overvoltages in high voltage power networks. Lightning and overvoltage protection. Insulation coordination.

Transient states involved by short-circuits and switching in power system. Earth-fault overvoltages in medium voltage networks. Voltage sags and interruptions - reasons and consequences. Power swings in electric power system. The ways of detection and prevention of power swings and limitation their bad consequences.

- Lecture:

<i>Particular lectures contents</i>	<i>Number of hours</i>
1. Introduction, characteristics of transient states and electromagnetic disturbances	1h

2. Direct and indirect lightning overvoltages	1 h
3. Wave phenomena in long lines	1 h
4. Kinds of internal overvoltages. Switching overvoltages	1 h
5. Resonance and dynamic overvoltages	2 h
6. Lightning protection, protection zones, electro-geometric theory	2 h
7. High voltage surge arresters in substations and lines	2 h
8. Insulation coordination in high voltage power systems	1 h
9. Short-circuit in a network and its elimination.	1 h
10. Asynchronous switching-on of a synchronous generator. Short-circuit on terminals.	1 h
11. Direct switching-on of an asynchronous machine. Short-circuit on terminals.	2 h
12. Voltage sags and interruptions. Overview of the reasons and consequences. Methods of mitigation.	2 h
13. Earth-fault overvoltages in medium voltage networks.	2 h
14. Transient states caused by short-circuits in power system	1 h
15. The reasons and consequences of power swings in electric power system.	1 h
16. The methods of damping of power swings.	1 h

- **Classes – the contents:**
Calculation of overvoltages and risk caused by lightning discharges.
Calculation of transient currents and voltages caused by short-circuits and switching-on generators, lines, transformers and capacitor banks. The examples of stochastic assessment of voltage sags caused by short-circuits in distribution networks.
- **Seminars – the contents:**
- **Laboratory – the contents:**
- **Project – the contents:**
- **Basic literature:**
 - 1. Flisowski Z., Technika wysokich napięć, WNT Warszawa 2000**
 - 2. Machowski J., Bernas S.: Stany nieustalone i stabilność systemu elektroenergetycznego. WNT Warszawa 1989.**
 - 3. Gonen T.: Modern power system analysis, 1988**
 - 4. Machowski J., Bialek S., Bumby J.: Power system dynamics and stability. John Wiley and Sons 1998.**
 - 5. Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych. WNT Warszawa 2002.**
- **Additional literature:**
 - 1. Bazelyan E.M., Raizer Yu.P., Lightning Physics and Lightning Protection, Institute of Physics Publishing, Bristol and Philadelphia, 2000**
 - 2. PN-EN 60909-0 Prądy zwarciove w sieciach trójfazowych prądu przemiennego- Część 0: Obliczanie prądów. Sierpień 2002.**
 - 3. Bollen M. H. J: Understanding Power Quality Problems. Voltage Sags and Interruptions. IEEE Press Series on Power Engineering. NY 2000.**
- **Conditions of the course acceptance/creditation: Completion of classes and pass of lecture**

* - depending on a system of studies