

DESCRIPTION OF THE COURSES

- Course code: ELR2311
- Course title: Advanced substations and electrical equipment
- Language of the lecturer: English

<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	0	0	1	0
<i>Number of hours/semester*</i>	30	0	0	15	0
<i>Form of the course completion</i>	Test			Completion of the project task	
<i>ECTS credits</i>	3(2,1)				
<i>Total Student's Workload</i>					

- Level of the course (basic/advanced): advanced
- Prerequisites: Mathematical analysis, Theory of circuits
- Name, first name and degree of the lecturer/supervisor:
Antoni Klajn, Ph. D.,
Waldemar Dołęga, Ph. D.
- Names, first names and degrees of the team's members:
- Year: 1..... Semester: 1.....
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course):

Understanding of the physical phenomena in electrical equipment. Know-how of the basic parameters of electrical devices and principles of designing. Understanding of relations between construction and operation principles, reliability as well as effectiveness of electrical equipment in transmission and supplying systems. Understanding of problems concerned with power substations.

- Form of the teaching (traditional/e-learning): traditional
- Course description:

Short circuit currents and its thermal and electro-dynamical effects in electrical equipment. Electric switching arc in various media. Low voltage and high voltage switching apparatus– classification, construction, main parameters, principles of design and operation. Transformers and measuring transformers in electrical power substations. Short-circuit current limitation. Over-voltage protection. Low voltage and high-voltage switchgears. Basic configurations and constructional solutions of high-voltage power substations with air and SF₆ insulation. Power supplying networks.

- Lecture:

<i>Particular lectures contents</i>	<i>Number of hours</i>
1. Short circuit current in power electric systems and its parameters considered in design of electrical equipment.	2
2. Thermal effects of currents in the normal and fault operation of the electrical network.	2
3. Elektro-dynamical effects of short circuit currents.	2
4. Electric arc – physical properties, extinguishing methods in AC and DC	

switches.	2
5. Switching apparatus- basic terminology and functions in power electrical networks. Low voltage switching apparatus.	2
6. High voltage switching apparatus – classification, construction, main parameters.	2
7. Transformers in power substations.	2
8. Current and voltage transformers in electrical power substations.	2
9. Over-voltages and over-voltage protection.	2
10. Limitation of fault currents. Short-circuit reactors.	2
11. Structures of main circuits in high-voltage electrical power substations. Supplying of industrial and residential load.	2
12. Constructional solutions of high-voltage air and SF ₆ insulated power substations	2
13. Earthing systems in electrical power networks.	2
14. Auxiliary devices in high-voltage power substations. Protection against electric shock in HV networks and substations.	2
15. Principles of operation in power substations.	2

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
- Project – the contents:

1. Description of the project subject - power electric installation LV or HV in industrial object.
2. Planning of the supplying network and structure of the installation.
3. Calculation of the power demand and design of power transformer.
4. Design of main circuits in the installation and design of load in normal operation conditions.
5. Design of wiring system.
6. Calculation of short-circuit currents.
7. Design of main switching apparatus and over-current protection.
8. Design of switchgear.
9. The system of protection against electric shock.
10. The final proof of all conditions wiring, over-current protection and its selectivity.
11. Design of over-voltage protection.
12. Design of measuring transformers and measuring system.
13. Control systems in the designed installation.
14. Preparing of project documentation.
15. Presentation of the work.

- Basic literature:
 1. McDonald J.D.: Electric Power Substations Engineering, Wiley, 2003.
 2. Seip G.: Electrical Installations Handbook, Springer Verlag, 2001.
 3. Switching, Protection and Distribution in Low-Voltage Networks, Siemens handbook, 1994.
- Additional literature:
 1. Garzon R.D.: High Voltage Circuit Breakers, Wiley, 2002.
 2. ABB Switchgear Manual, 10th edition, Düsseldorf, Cornelsen Verlag, 1999.
- Conditions of the course acceptance/creditation:

1. Lecture: completion of the test
2. Project: completion of the project task.

* - depending on a system of studies