

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Zaawansowane stacje i urządzenia elektroenergetyczne**  
 Name in English: **Advanced Substations and Electrical Equipment**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable): **Renewable Energy Systems**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **optional**  
 Subject code: **ELR032335**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30			15	
Number of hours of total student workload (CNPS):	90			30	
Form of crediting:	examination			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	3			1	
including number of ECTS points for practical (P) classes :				1	
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10			0.70	

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Possesses a knowledge in the field of the fundamentals of electrotechnics.
2. Has a basic knowledge in the field of the theory of electric circuits.
3. Can correctly and effectively apply a knowledge of linear algebra and analytical geometry to qualitative and quantitative analysis of mathematical issues connected with studied engineering branch.
4. Can apply a mathematical apparatus to analysis of linear electric circuits with sinusoidal AC force.
5. Can apply a mathematical apparatus to analysis of temporary states in linear electrical circuits.
6. Understands a need and knows possibilities of continuous education, increasing of professional, personal and social competences.
7. Has awareness of responsibility for own work.

**SUBJECT OBJECTIVES**

- C1. Possession a knowledge of physical phenomena occurred in electrical devices.
- C2. Possession a knowledge of important parameters of electrical devices in aspect of their designing.
- C3. Getting to know of principles of electrical devices designing.
- C4. Getting to know of relations between construction, correct exploitation, reliability and effectiveness of use of electrical devices in power network.
- C5. Possession a knowledge of function of power substations.
- C6. Acquisition of abilities to design low voltage electrical installation for supply of different electricity receivers in objects with varied character of use.
- C7. Acquisition of abilities to design MV electrical installation for supply of object with varied character of use.
- C8. Acquisition of abilities to selection of LV and MV switchgears and MV/LV container transformer substations for required work conditions.

## SUBJECT EDUCATIONAL EFFECTS

*relating to knowledge:*

- PEK\_W01 Knows physical phenomena occurred in electrical devices.
- PEK\_W02 Knows of principles of electrical devices designing.
- PEK\_W03 Possesses a knowledge of function of power substations.

*relating to skills:*

- PEK\_U01 Can design low voltage electrical installation for supply of different electricity receivers in objects with varied character of use.
- PEK\_U02 Can design MV electrical installation for supply of object with varied character of use.
- PEK\_U03 Can select LV and MV switchgears and MV/LV container transformer substations for required work conditions.

*relating to social competences:*

- PEK\_K01 Can think and act in creative and enterprising way. He/she is able to rank appropriately the priorities needed for realizing the respective task.

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Short circuit currents in power electric systems, characteristic values and parameters, ways of their calculation.	2
Lec 2	Thermal effects of normal and short circuit currents.	2
Lec 3	Electro-dynamical effects of short circuit currents.	2
Lec 4	Electric arc – physical properties, extinguishing methods of arc.	2
Lec 5	Switching apparatus - basic terminology and functions in power electrical networks. Low voltage switching apparatus.	2
Lec 6	High voltage switching apparatus – classification, construction, main parameters.	2
Lec 7	Power transformers in power substations.	2
Lec 8	Current and voltage transformers in electrical power substations.	2
Lec 9	Over-voltages and over-voltage protection.	2
Lec 10	Limitation of fault currents. Short-circuit reactors.	2
Lec 11	Structures of main circuits in high-voltage electrical power substations. Supplying of industrial and residential load.	2
Lec 12	Constructional solutions of air and SF6 insulated indoor power substations.	2
Lec 13	Earthing systems in power substations.	2
Lec 14	Auxiliary devices in high-voltage power substations. Protection against electric shock in power substations.	2
Lec 15	Principles of correct operation in power substations.	2
Total hours:		<b>30</b>

Form of classes - project		Number of hours:
Proj 1	Description of the project task. Planning of the supply of object with varied character of use and structure of the installation.	2
Proj 2	Project of general lighting in the object.	2
Proj 3	Calculation of the power demand for the object. Calculation of reactive power compensation. Selection of capacitor bank. Selection of power transformers.	2
Proj 4	Selection of main cable supplied the object with varied character of use.	2
Proj 5	Calculation of selected circuits of power installation.	2
Proj 6	Selection of LV switchgears in the object with varied character of use.	2
Proj 7	Selection of MV/LV container power substations.	2
Proj 8	Project documentation.	1
Total hours:		<b>15</b>

## TEACHING TOOLS USED

- N1. Lecture with the use of audiovisual techniques, multimedia presentations.
- N2. Multimedia presentation.
- N3. Problem discussion.
- N4. Presentation of the project
- N5. Consultations.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Exam in written form.
P(W)	P=F1	
F1(P)	PEK_U01 PEK_U02 PEK_U03	Assessment of project preparing.
F2(P)	PEK_U01 PEK_U02 PEK_U03	Defence of the project.
P(P)	P=0.6*F1+0.4*F2	

PRIMARY AND SECONDARY LITERATURE
<b>PRIMARY LITERATURE:</b> [1] Dołęga W., Advanced substations and electrical equipment. Wrocław University of Technology, Wrocław, 2011. [2] McDonald J.D., Electric Power Substations Engineering, Wiley, 2003. [3] Seip G., Electrical Installations Handbook, Springer Verlag, 2001. [4] ABB Switchgear Manual, 10th edition, Düsseldorf, Cornelsen Verlag, 1999.
<b>SECONDARY LITERATURE:</b> [1] Garzon R.D., High Voltage Circuit Breakers, Wiley, 2002. [2] Switching, Protection and Distribution in Low-Voltage Networks, Siemens handbook, 1994.

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT <b>ELR032335 - Advanced Substations and Electrical Equipment</b> AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY <b>Electrical Engineering</b> AND SPECIALIZATION <b>Renewable Energy Systems</b>				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	S2RES_W15	C.1	Lec1 Lec2 Lec3 Lec4	N.1
PEK_W02	S2RES_W15	C.2 C.3 C.4	Lec5 Lec6 Lec7 Lec8 Lec9 Lec10	N.1
PEK_W03	S2RES_W15	C.5	Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_U01	S2RES_U16	C.6	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8	N.2 N.3 N.4 N.5
PEK_U02	S2RES_U16	C.7	Proj1 Proj3 Proj7 Proj8	N.2 N.3 N.4 N.5
PEK_U03	S2RES_U16	C.8	Proj6 Proj7 Proj8	N.2 N.3 N.4 N.5
PEK_K01	S2RES_K01	C.6 C.7 C.8	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Proj8	N.2 N.3 N.4 N.5