

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Integracja zasobów rozproszonych w systemie elektroenergetycznym**
 Name in English: **Integration of dispersed energy sources in electric power system**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Renewable Energy Sources**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052216**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30				
Number of hours of total student workload (CNPS):	60				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	2				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows working principles of electrical distribution networks and power substations
2. Knows methods and technology of energy production from fossil and renewable sources
3. Knows and understands the definitions of power quality and supply reliability parameters

SUBJECT OBJECTIVES

- C1. Acquaintance with classification and definitions of dispersed sources connected to power system and with technical conditions of integration of such sources in power system
 C2. Acquaintance with formal procedures of application for power generation units connected to power system
 C3. Acquaintance with methodology of analysis of dispersed sources impact on power system operation
 C4. Acquaintance with impact of dispersed energy sources on customer supply reliability.
 C5. Acquaintance with technical requirements for the connection of micro-generation units and micro-networks to LV network

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 Has knowledge about technical characteristics of dispersed sources and understands technical limitations for their integration in power system
 PEU_W02 Knows procedure of connecting of dispersed sources to power system and understands their impact on power system and on customer supply reliability
 PEU_W03 Knows requirements for connecting single micro-generators to LV network and understand principles of operation of micro-networks.

*relating to skills:**relating to social competences:*

- PEU_K01 Is able to determine priorities for assigned task

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Definition and classification of dispersed energy sources	2
Lec 2	Technical limitation for dispersed energy sources development	2
Lec 3	Criteria of connection of dispersed generation to power system	2
Lec 4	Application for technical condition of dispersed generation connection to distribution network	2
Lec 5	Expertise of dispersed sources impact on power system	2
Lec 6	Standards and regulations requirements and methodology for determination of dispersed sources impact on operation conditions of distribution network	2
Lec 7	Power flow and voltage levels analysis in distribution network with dispersed sources	2
Lec 8	Short circuit calculation in distribution network with dispersed sources	2
Lec 9	Dispersed sources impact on power quality	2
Lec 10	Dispersed sources impact on customer supply reliability	2
Lec 11	Requirements for safe island operation of dispersed sources	2
Lec 12	Connection of microgenerations to a low voltage network	2
Lec 13	Autonomic operation of micro-sources	2
Lec 14	Principles of controls of sources operating in micro-network	2
Lec 15	Final test	2
Total hours:		30

TEACHING TOOLS USED
N1. Problem lecture
N2. Lecture with use of audiovisual techniques, multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation <i>F - forming (during semester)</i> <i>P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Oral and/or written evaluation test
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Kacejko P., Generacja rozproszona w systemie elektroenergetycznym. Wydawnictwo Uczelniane, Politechnika Lubelska, Lublin 2004. [2] Lubośny Z., Elektrownie wiatrowe w systemie elektroenergetycznym, WNT, Warszawa, 2006. [3] Gawlik L., et al., Rozproszone zasoby energii w systemie elektroenergetycznym, Instytut Gospodarki Surowcami Mineralnymi i Energią Polskiej Akademii Nauk, Wydawnictwo IGSMiE PAN, Kraków 2011. [4] Paska J., Wytwarzanie rozproszonej energii elektrycznej i ciepła, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2010 SECONDARY LITERATURE: [1] Konspekt wykładów [2] Bollen M., Fainan H., Integration of distributed generation in the power system, Hoboken, IEEE Press, Wiley, cop. 2011

SUBJECT SUPERVISOR
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