FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Wytwarzanie energii elektrycznej**
Name in English:	**Electric energy generation**
Main field of study (if applicable):	**Control Engineering and Robotics**
Specialization (if applicable):	**Automation and Control in Electrical Power Systems**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**ARR042517**
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):	60	30			
Form of crediting:	examination	crediting with grade			
For group of courses mark (X) final course:					
Number of ECTS points:	2	1			
including number of ECTS points for practical (P) classes :		1			
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40	0.70			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of classical mechanics and phenomenological thermodynamics
2. Is able to apply correctly and effectively physical laws and principles for qualitative and quantitative analysis of engineering related physical problems

SUBJECT OBJECTIVES

C1. Having basics knowledge of physical phenomena in electric energy generation in various types of energy sources
C2. Having basics knowledge of electricity generation technologies.
C3. Having basics knowledge of electricity generation costs and protecting an environment in electricity generation
C4. Be able to make computations related to energy conversion and economic analysis of electric power generation

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Has basic knowledge of physical phenomena occurring in electric energy generation process
PEK_W02	Has knowledge of basic electric energy generation technologies
PEK_W03	Has knowledge of influence of electricity generation on natural environment

relating to skills:

PEK_U01	Is able to make basic calculations related to energy transformations in electric power energy sources
PEK_U02	Is able to make basic calculations related to economic analysis of electricity generation

relating to social competences:

PEK_K01	Is aware of necessity of self-reliant information retrieval and creative using of obtained information

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Scope of the course. Crediting requirements. Basic definitions. Forms and carriers of energy. Electrical energy generation methods. Energy resources and energy demand. Structure of electrical energy generation in Poland and in the world	2
Lec 2	Physical principles of energy conversion. Thermodynamic laws, water steam thermodynamic properties. Thermodynamic cycles and their efficiency	2
Lec 3	Conventional thermal power plants: overview. Basic and auxiliary devices of thermal power plants	2
Lec 4	Thermodynamic cycle of thermal power plant. Efficiency improvement methods. Future development of thermal power plants	2
Lec 5	Combined heat and power (CHP) production: overview. Energy conversion in CHP. Efficiency of CHP	2
Lec 6	Gas turbine and combined gas-steam based power plants: thermodynamic cycles, layout and devices	2
Lec 7	Electrical energy generations with reciprocating engines	2
Lec 8	Hydro power plants: overview, classification, operation principles. Conversion of hydro energy	2
Lec 9	Characteristic of basic type of hydro turbines. Small hydro power plants. Wind power energy: fundamentals	2
Lec 10	Wind power turbines and plants: principles of operation, construction. Energy from wind: basic calculations	2
Lec 11	Electrical energy generation in PV plants: fundamentals and basic calculations	2
Lec 12	Biomass in energy generation. Plants based on ORC. Micro-sources, hydrid power generation technologies	2
Lec 13	Nuclear energy: characteristic. Basics of nuclear reactions. Nuclear reactors. Thermodynamics and efficiency of nuclear power plants. Safety and future developments in nuclear energy	2
Lec 14	Economic and social costs of energy production in conventional and renewable sources	2
Lec 15	Electrical energy conversion and natural environment. Protection of environment in electric energy generation – basic concepts. Lecture short review	2
	Total hours:	**30**

Form of classes - class		**Number of hours:**
Cl 1	Course introduction. Work and heat. First law of thermodynamics. Basic thermodynamic processes	2
Cl 2	Second law of thermodynamics. Thermodynamic cycles and their efficiency. Thermodynamic properties of water steam	2
Cl 3	Thermodynamic cycle of thermal power plant and its efficiency	2
Cl 4	Energy conversion and efficiency in Combined Heat and Power (CHP)	2
Cl 5	Energy conversion and efficiency in combined gas-steam power plants	2
Cl 6	Basic technical and economic calculations for hydro electric power plants	2
Cl 7	Wind power plants: basic calculations for technical and economic efficiency assessment	2
Cl 8	Final test	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Information lecture with use of multimedia presentation
N2. Solving calculation tasks, case studies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Writing exam
P(W)	P=F1	
F1(C)	PEK_U01 PEK_U02	Writing tests. Activity during classes
F2(C)	PEK_U01 PEK_U02	Final test
P(C)	P=0.4F1+0.6F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Paska J., Wytwarzanie energii elektrycznej, OWPW, Warszawa 2005.
[2] Paska J., Wytwarzanie rozproszone energii elektrycznej i ciepła, OWPW, Warszawa 2010.
[3] Marecki J., Podstawy przemian energetycznych, WNT, Warszawa 2014.
[4] Chmielniak T., Technologie energetyczne, WNT, Warszawa 2008.

SECONDARY LITERATURE:

[1] Pawlik M., Strzelczyk F., Elektrownie, WNT, Warszawa 2010.
[2] Szargut J., Zadania z termodynamiki technicznej, Wyd. Pol. Śląskiej, Gliwice 2013.
[3] Skorek J., Kalina J., Gazowe układy kogeneracyjne. WNT, Warszawa 2005.

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR042517 - Electric energy generation
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**
AND SPECIALIZATION **Automation and Control in Electrical Power Systems**

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	S2ASE_W12	C.1	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N.1
PEK_W02	S2ASE_W12	C.2	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N.1
PEK_W03	S2ASE_W12	C.3	Lec14 Lec15	N.1
PEK_U01	S2ASE_U11	C.4	Cl1 Cl2 Cl3 Cl4 Cl5 Cl6 Cl7 Cl8	N.2
PEK_U02	S2ASE_U11	C.4	Cl1 Cl2 Cl3 Cl4 Cl5 Cl6 Cl7 Cl8	N.2
PEK_K01	K2AiR_K06	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15 Cl1 Cl2 Cl3 Cl4 Cl5 Cl6 Cl7 Cl8	N.1 N.2