FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Wytwarzanie energii elektrycznej**
Name in English:	**Electric energy generation**
Main field of study (if applicable):	**Industrial Control Engineering**
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:	**APR012517**
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 LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Has basic knowledge of physical phenomena occurring in electric energy generation process
PEU_W02	Has knowledge of basic electric energy generation technologies
PEU_W03	Has knowledge of influence of electricity generation on natural environment

relating to skills:

PEU_U01	Is able to make basic calculations related to energy transformations in electric power energy sources
PEU_U02	Is able to make basic calculations related to economic analysis of electricity generation

relating to social competences:

PEU_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. Conditions of passing. Introductory concepts. Characteristics of electrical energy. Forms and energy carriers. Energy conversion and methods of electricity generation. The structure of electricity generation in Poland and in the world. Consumption and forecast for electrical energy demand	2
Lec 2	Thermal cycles in energy conversion: thermodynamic principles, efficiency of circuits, thermodynamic properties of water steam	2
Lec 3	Steam power plant thermal cycle and layout. The efficiency of the cycle and ways for improvement. Technological process of a steam power plant	2
Lec 4	Basic equipment of steam power plant. Directions for the development of steam power plants	2
Lec 5	Combined heat and power (CHP) generation: overview. Layout and efficiency of steam CHP plants. Energy balance of CHP	2
Lec 6	Gas turbine and combined cycle power plants: thermodynamic cycle, construction, operation and applications. Energy balance of combined cycle power plants	2
Lec 7	Generating sets with reciprocating engines: thermodynamic cycles, construction, operation and application	2
Lec 8	Hydro energy and hydro power plants: overview. Physical principles of hydro energy conversion. Pump-storage, run-off-river and pondage hydro power plants. Energy production assessment. Types of hydro turbines and its selection	2
Lec 9	Wind energy: characteristics. The physical principles of wind energy conversion. Estimation of energy produced in wind power plants. Construction and operation of wind turbines	2
Lec 10	Solar radiation energy. Electric energy production in photovoltaic cells and panels	2
Lec 11	Energy production in electrochemical and fuell cells. Methods of energy storage	2
Lec 12	Power plants based on Organic Rankine Cycle (ORC). Biomass and geothermal energy for electricity production	2
Lec 13	Nuclear power: overview. Physical principles of the energetic use of nuclear reactions. Construction and operation of nuclear reactors. Systems with a pressure and boiling reactor. Nuclear energy security and its development in domestic conditions	2
Lec 14	Economic and social costs of energy production in conventional and renewable sources	2
Lec 15	Electrical energy generation and its influence on natural environment: main problems. 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 cycles of thermal power plants. Energy balance and its efficiency of thermal power plant	2
Cl 4	Energy conversion and efficiency in Combined Heat and Power (CHP). Energy balance of CHP plant	2
Cl 5	Energy conversion in combined cycle gas-steam power plants. Energy balance of combined cycle plant	2
Cl 6	Run-off-river and pondage hydro power plants: basic technical and economic calculations	2
Cl 7	Wind power plants: basic technical and economic calculations	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 LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Writing exam
P(W)	P=F1	
F1(C)	PEU_U01 PEU_U02	Writing tests. Activity during classes
F2(C)	PEU_U01 PEU_U02	Final test
P(C)	P=0.4F1+0.6F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Paska J., Wytwarzanie energii elektrycznej, OWPW, Warszawa 2018.
[2] Paska J., Rozproszone źródła energii, OWPW, Warszawa 2017.
[4] Lewandowski W., Klugmann-Radziemska E., Proekologiczne odnawialne źródła energii. Kompendium, PWN, Warszawa 2017.
[4] Marecki J., Podstawy przemian energetycznych, WNT, Warszawa 2013.
[5] Pawlik M., Strzelczyk F., Elektrownie, WNT, Warszawa 2010.

SECONDARY LITERATURE:

[1] Chmielniak T., Technologie energetyczne, WNT, Warszawa 2008.
[2] Kalinowski E., Termodynamika. OWPWr, Wrocław 1994.
[3] Paska J., Wytwarzanie rozproszone energii elektrycznej i ciepła, OWPW, Warszawa 2010.
[4] Skorek J., Kalina J., Gazowe układy kogeneracyjne. WNT, Warszawa 2005.

SUBJECT SUPERVISOR

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