FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Scentralizowane i zdecentralizowane technologie wytwarzania energii**
Name in English:	**Centralized and decentralized electricity generation technologies**
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:	**ELR042519**
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. Knows energy conversions applied in electric power generation, heat and cold
2. Knows principles of energy production using fossil fuels and renewable resources
3. Knows theoretical principles of thermodynamic processes in electric power generation, heat and cold
4. Knows basic operation rules of equipment for electric power, heat and cold production with power system and energy storage devices

SUBJECT OBJECTIVES

C1. Be familiar with using of primary energy resources for electricity, heat and cold production
C2. Be familiar with thermodynamic cycles using in energy production and know the ways of improving their efficiency
C3. Be familiar with technologies of electricity, heat and cold production with use of renewable sources
C4. Be familiar with methods for technical and economic assessment of electrical energy, heat and cold production devices

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Has knowledge on thermal engine cycles and energy conversion processes
PEK_W02	Has knowledge on construction of technology plants for electric energy, hot and cold production; energy balancing of these plants
PEK_W03	Has knowledge on cost assessment of electricity, heat and cold production

relating to skills:

PEK_U01	Be familiar on creating energy balance of electric energy production plant in analytical form and Sankey chart
PEK_U02	Be able to interpret energy characteristics of electric energy production plants and calculate basic technical indices
PEK_U03	Be able to calculate electricity costs in various types of power plants

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	Lecture introduction. Primary and useful energy carriers. 1-, 2- and 3-step energy conversion processes in energy production	2
Lec 2	Coal fired thermal power plants. Carnotization of Rakine cycle	2
Lec 3	Conventional CHP steam plants, public and industrial	2
Lec 4	Gas and gas-steam electric power plants and CHP	2
Lec 5	Electric power plants and CHP using Organic Rankine Cycle (ORC) and Kalina cycle	2
Lec 6	Energy storage device in energy production plants	2
Lec 7	Nuclear power plants: construction, opetation, types, evironmental security	2
Lec 8	Water power plants: run-off river, low-, medium and high-head	2
Lec 9	Water power plants: pump-storage, water reservoirs	2
Lec 10	Wind power plants, power and energy production raleted to wind speed, power regulation, costs of electricity production	2
Lec 11	Power plants using biogas obtained from agricultural feedstock and municipal waste	2
Lec 12	Solar electric power and heat plants. Energy storage systems	2
Lec 13	Geothermic and geothermal electric power and heat plants	2
Lec 14	Fuel cells, energy balance, reforming, hybrid systems	2
Lec 15	Distributed and dispersed energy sources	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction: form of exercise reports, processing of measurements results, safety rules.	1
Lab 2	Air kinetic energy as a primary source of energy: wind speed measurements, power of air stream and power produced by wind power plant	2
Lab 3	Wind power plant: power and energy characteristic, efficiency, power, voltage, frequency, flickers	2
Lab 4	Sun electromagnetic radiation: radiation measurements on Earth surface, correlation between components, radiation on sloping surface	2
Lab 5	PV cells: characteristic, efficiency, cooperation with energy storage system	2
Lab 6	Fuel cells: characteristic, efficiency	2
Lab 7	Production, transport and distribution cost of electrical energy, heat and cold in separated and combined systems. External costs	2
Lab 8	Sankey chart in technological systems with recuperation and without recuperation	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Information lecture in form of multimedia presentation
N2. Laboratory made in traditional way

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(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Average of notes for entry tests
F2(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Average of notes for reports
P(L)	P=0.4F1+0.6F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kalinowski E., Termodynamika. OWPWr, Wrocław 1994.
[2] Domański R. i inni. Wybrane zagadnienia z termodynamiki w ujęciu komputerowym, PWN, Warszawa 2000.
[3] Paska J., Wytwarzanie energii elektrycznej, OWPW, Warszawa 2008.
[4] Pawlik M. , Strzelczyk F. , Elektrownie, WNT, Warszawa 2009.
[5] Chmielniak T., Technologie energetyczne, PWN, Warszawa 2010.
[6] Michałowski S., Plutecki J., Energetyka wodna , WNT, Warszawa 1976.
[7] Boczar T.: Energetyka wiatrowa. Aktualne możliwości wykorzystania, WPA K, Warszawa 2007.
[8] Skorek J., Kalina J., Gazowe układy kogeneracyjne. WNT, Warszawa 2005.

SECONDARY LITERATURE:

[1] Chmielniak T. J. i inni, Turbiny gazowe . Wyd. Zakład Narodowy im. Ossolińskich PAN, Warszawa 2001
[2] Bartnik R., Rachunek efektywności techniczno-ekonomicznej w energetyce zawodowej. OWPO, Opole 2008
[3] Paska J., Ekonomika w elektroenergetyce. OWPW, Warszawa 2007.
[4] Szargut J., Ziębik A., Podstawy energetyki cieplnej. PWN, Warszawa 2000.

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR042519 - Centralized and decentralized electricity generation technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Renewable Energy Sources**

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	S2OZE_W01	C.1 C.2	Lec1 Lec2	N.1
PEK_W02	S2OZE_W01	C.3	Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_W03	S2OZE_W01	C.4	Lec2 Lec7 Lec10	N.1
PEK_U01	S2OZE_U01	C.3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab8	N.2
PEK_U02	S2OZE_U01	C.3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab8	N.2
PEK_U03	S2OZE_U01	C.4	Lab7	N.2
PEK_K01	K2ETK_K01	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.1 N.2