FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name in Polish	Systemy energetyczne
Name in English	**ENERGY SYSTEMS**
Main field of study	Power Engineering
Specialization	Computer aided mechanical and power engineering
Level and form of studies	2nd level, full-time
Kind of subject	obligatory
Subject code	W09ENG-SM0040
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	crediting with grade	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					
including number of ECTS points for direct teacher-student contact (BK) classes	1	0.75			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of thermodynamics, heat transfer, machine design and energy generation in power plant and CHP.
2. Skills of solving simple problems in a chosen worksheet (eg. Excel, Mathcad)

SUBJECT OBJECTIVES

C1 – Demonstrate an understanding of the fundamentals and laws governing energy conversion.
C2 – Discuss issues related to the performance of conventional power-generation plants.
C3 - Present trends toward renewable sources of electricity.
C4 - A study of steam generation and utility plants, including cogeneration, gas turbine, and combined cycles.
C5 – Demonstrate features of advanced power plants.
C6 – Perform engineering calculations.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 - Demonstrate a comprehensive understanding of the fundamentals and laws governing conversion of energy.
PEK_WO2 - Perform the analysis of cogeneration, combined and integrated cycles for conventional and advanced technologies.
PEK_W03 - Understand the operation and major components of electricity generating and CHP plants.
PEK_W04 - Select the type of plant appropriate for a given application.
PEK_W05 - Perform basic analyses associated with each subsystem and component of the plant.
PEK_W06 - Overall picture of the applied fields for cogeneration systems.
PEK_W07 - Define mathematical model to assess particular energy system.

relating to skills:

PEK_U01 - Perform engineering calculations encountered in practice.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec 1	Introductory lecture. Energy and electricity fundamentals. Terminology. Numerical Steam Tables.	2
Lec 2	Steam power plants. Thermodynamic principles. Fuels. Steam power generation cycles.	2
Lec 3	Steam power plants. Performance improvement. Mathematical modeling.	2
Lec 4	Gas turbine and combined-cycle power plants: Gas turbine engines and performance. Gas turbine cycles. Combined-cycle power plants.	2
Lec 5	Gas turbine and combined-cycle power plants: Gas turbine engines and performance. Gas turbine cycles. Combined-cycle power plants.	2
Lec 6	CHP systems: CHP schemes (micro-scale CHP systems, small scale CHP systems, large scale CHP systems including district heating schemes).	2
Lec 7	CHP systems: CHP schemes (micro-scale CHP systems, small scale CHP systems, large scale CHP systems including district heating schemes).	2
Lec 8	Diesel- and gas-engine power plants: Diesel engines. Fuels. Emission control. Heat recovery systems	2
Lec 9	Description and evaluation of Organic Rankine Cycle.	2
Lec 10	Organic Rankine Cycle. Numerical Tables of different working fluids. Mathematical modelling.	2
Lec 11	Solar energy principles.	2
Lec 12	Solar photovoltaics and thermal energy.	2
Lec 13	Pinch Technology Analysis.	2
Lec 14	Fuel cells: Definition and principles of operation. Losses and efficiency. Possible fuels. Fuel-cell technologies and applications (alkaline fuel cells, molten carbonate fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and regenerative fuel cells).	
Lec 15	Course summary. Final test.	2
	Total hours	**30**
Form of classes - tutorial		**Number of hours**
Cl 1	Numerical Steam Tables – simple examples.	2
Cl 2	Analysis of simple and complex energy systems – using CYCLE TEMPO tool.	2
Cl 3	Analysis of simple and complex energy systems – using CYCLE TEMPO tool.	2
Cl 4	Analysis of simple and complex energy systems – defining algorithm in a chosen worksheet.	2
Cl 5	Design of energy system utilizing renewable source of energy and waste heat.	2
Cl 6	Design of Heat Recovery Steam Generator.	2

Cl 7	Pinch Point Analysis case study.	2
Cl 8	Final test.	1
	Total hours	**15**

TEACHING TOOLS USED
N1. Lecturing with multimedia - computer presentation N2. Calculation worksheets MathCad, Excel and engineering tool CYCLE-TEMPO N3. Case studies. N4. Discussion and consultancy.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT- lecture

Evaluation (F– forming (during semester), C– concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
C	PEK_W01÷PEK_W07	Final test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT- class

Evaluation (F– forming (during semester), C– concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Discussion
C	PEK_U01	Final Test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE :

[1] M. M. El-Wakil, Powerplant Technology, McGraw-Hill, 1984 or 2002.
[2] Culp, Principles of Energy Conversion, 2nd Edition, 1991.
[3] Weisman & Eckart, Modern Power Plant Engineering, 1985
[4] Combined-Cycle Gas & Steam Turbine Power Plants. Kehlhofer, R..ISBN 0-88173-076-9

SECONDARY LITERATURE:

[1] Cycle - Tempo, Reference Guide, TUDelft ….
[2] Nye, David E. Consuming Power: A Social History of American Energies. The MIT Press: Cambridge, MA, 1999

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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