FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish:	Modelowanie systemów HVAC
Name of subject in English:	Modeling of HVAC systems
Main field of study (if applicable):	Energetyka
Specialization (if applicable):	Computer aided mechanical and power engineering
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	optional/specialization
Subject code:	W09ENG-SM0054
Group of courses:	NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	examination		crediting with grade		
For group of courses mark final course with (X)					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BU) classes	1		1.5		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competence in thermodynamics and heat exchange
2. Basic knowledge of issues related to air conditioning and heating

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SUBJECT OBJECTIVES

C1 - To familiarize students with the basic elements of HVAC installations.
C2 - To familiarize students with the principle of operation and operation of HVAC systems.
C3 - To familiarize students with examples of real HVAC systems.
C4 - To develop skills in performing simulations for simple and complex HVAC installations.

SUBJECT LEARNING OUTCOMES

relating to knowledge:
PEU_W01 – Has knowledge of the various elements of the HVAC system.
PEU_W02 – Has knowledge of the principles of operation and use of HVAC systems.
relating to skills:
PEU_U01 – Student is able to present devices included in the HVAC installation.
PEU_U02 – Student can choose the parameters of the HVAC installation.

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction	2

Lec 2	Fundamentals of thermal comfort, psychrometrics, and thermodynamics	2
Lec 3	The load sub-system air-conditioning equipment	2
Lec 4	The heat and hot water production sub-system part 1	2
Lec 5	The heat and hot water production sub-system part 2	2
Lec 6	The cold production sub-system part 1	2
Lec 7	The cold production sub-system part 2	2
Lec 8	Thermal energy storage methods: sensible and latent	2
Lec 9	Seasonal thermal energy storage for heating and cooling capacity	2
Lec 10	Monitoring and control systems	2
Lec 11	Smart solar-assisted HVAC case study	2
Lec 12	System configuration: examples, operation and maintenance strategies	2
Lec 13	Performance figures: Energy-economic and environmental impact of HVAC systems	2
Lec 14	Polygeneration systems	2
Lec 15	Introduction to district heating and cooling systems	2
	Total hours	30

Laboratory		**Number of hours**
Lab 1	Introduction to the course.	2
Lab 2	The use of meteo data in the TRNSYS program.	2
Lab 3	Project of installation with water heater.	2
Lab 4	Installation with a heater - change of operating parameters.	2
Lab 5	The use of experiment planning techniques in plant simulations.	2
Lab 6	Design of domestic hot water system - part 1	2
Lab 7	Design of domestic hot water system - part 2	2
Lab 8	Installation with two storage tanks - part 1	2
Lab 9	Installation with two storage tanks - part 2	2
Lab 10	Project of installation with a rock bed storage.	2
Lab 11	Introduction to the TRNBuild module.	2
Lab 12	Modeling of a single-zone building - creation of geometry and material data.	2
Lab 13	Modeling of a one-zone building - HVAC system.	2
Lec 14	Data and results analysis possibilities in TRNSYS program.	2
Lec 15	Additional term	2
	Total hours	30

TEACHING TOOLS USED

N1. Informative lecture using a multimedia presentation
N2. Students' own work - preparation for passing
N3. Consultations
N4. The program for conducting simulations - TRNSYS v. 18.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT - Lecture

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P	PEU_W01 - PEU_W02	Examination

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT - Laboratory

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F	PEU_U01 - PEU_U02	Laboratory reports

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Wang SK, Handbook of air conditioning and refrigeration. 2nd ed. McGraw-Hil; 2011.
[2] Cengel Y, Heat Transfer: a practical approach. 2nd ed. WCBMcGraw-Hill, United States of America; 1998.
[3] Duffie JA and Beckman WA, Solar Engineering of thermal processes, 2nd ed. John Wiley and Sons.
[4] Dincer I and Rosen MA,Thermal energy storage systems and applications, 2nd ed. John Wiley and Sons; 2011.

SECONDARY LITERATURE:

[1] Applied Energy Journal
[2] Renewable Energy Journal
[3] Solar Energy Journal

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

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*delete if not necessary