Załącznik nr 6 do ZW 121/2020

FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish Systemy klimatyzacyjne
Name of subject in English **Air conditioning systems**
Main field of study (if applicable): Power engineering
Specialization (if applicable): Refrigeration and Cryogenics
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: optional
Subject code W09ENG-SM0076
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 classes (P)			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1		0,75		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Technical Thermodynamics
2. Fluid Mechanics

SUBJECT OBJECTIVES

C1 Acquisition of practical knowledge, regarding air-condition systems, their design and application.
C2. Development of skills how to design and analyze air-conditioning systems

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 – has knowledge of rules and standards for design and operation of air-condition systems
PEU_W02 - have knowledge of the design of air-conditioning installations

relating to skills:
PEU_U01 - can determine the basic parameters of the air-conditioning system and indicate characteristic points of refrigeration cycle.
PEU_U02 - can conclude from the measurements of air-conditioning system operating parameters

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Overview of the lecture. Introduction. Air-conditioning processes. Air flow and thermal comfort.	2
Lec 2	Air-conditioning processes thermodynamic basics. Humid air properties.	2
Lec 3	Psychrometric diagram. Heating, cooling and dehumidifying. Air mixing.	2
Lec 4	Indoor air quality. Leakage paths. Heating and cooling load calculations.	2
Lec 5	Heating and humidifying systems. Influence of air relative humidity level on energy demand of heating systems.	2
Lec 6	Refrigeration cycle for air-conditioning. Required temperature levels.	2
Lec 7	Ventilation systems. Air distribution. Evaporative cooler.	2
Lec 8	Air duct design. Heat exchange with surroundings. Convective and radiant heat loads.	2
Lec 9	Piping connection methods in air-conditioning systems.	2
Lec 10	Heat recovery. Heat exchangers for air-conditioning.	2
Lec 11	Thermal storage systems (cold water, ice slurry, ice harvesting, PCM). Centrifugal chillers and capacity control.	2
Lec 12	Resorption systems. Individual air-conditioning systems.	2
Lec 13	Individual air-conditioning systems. Requirements, safety control.	2
Lec 14	Ecological issues of HVAC systems.	2
Lec 15	Colloquium	2
	Total hours	30

Laboratory		Number of hours
Lab 1	Thermodynamic changes of moist air inside the air washer; adiabatic cooling.	2
Lab 2	Dehumidification of moist air	2
Lab 3	Measurements of working parameters of the split air conditioner	2
Lab 4	Testing the ducted system air conditioning at varying load	2
Lab 5	Measurements of working parameters of the countercurrent flow recuperative heat exchanger	2
Lab 6	Measurements of working parameters of the spiral countercurrent flow recuperative heat exchanger	2
Lab 7	Testing the portable air conditioner	2
Lab 8	Corrective and supplementary classes	1
	Total hours	15

TEACHING TOOLS USED

N1. Lecture with presentation
N2. Laboratory – discussion of problems
N3. Self-study – study and preparation for the final exam.
N4. Office hours.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	PEU_W01 – PEU_W02	Mark of the colloquium
P2	PEU_U01 – PEU_U02	Reports from laboratory classes

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 2009 ASHRAE Handbook - Fundamentals (SI Edition), © 2009 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

[2] 2011 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning Applications (SI Edition), © 2011 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

[3] ASHRAE GreenGuide - The Design, Construction, and Operation of Sustainable Buildings (3rd Edition), © 2010 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

[4] Vedavarz A., Kumar S., Hussain M.I., HVAC - The Handbook of Heating, Ventilation and Air Conditioning for Design and Implementation., © 2007 Industrial Press

SECONDARY LITERATURE:

[1] Farida M.M., Khudhaira A.M., Razackb S.A.K., Al-Hallajb S., A review on phase change energy storage: materials and applications., Energy Conversion and Management, Volume 45, Issues 9–10, June 2004, Pages 1597–1615

[2] Sharmaa A., Tyagib V.V., Chena C.R., Buddhib D., Review on thermal energy storage with phase change materials and applications, Renewable and Sustainable Energy Reviews, Volume 13, Issue 2, February 2009, Pages 318–345

[3] U.S. Department of Energy, Air Distribution System Design: Good Duct Design Increases Effciency

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

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