Air conditioning systems

Faculty of	**Mechanical and Power Engineering**
Name in English	**Air conditioning systems**
Name in Polish	**Systemy klimatyzacyjne**
Main field of study	**Power Engineering**
Specialization	**-**
Level of studies	**II level**
Form of studies	**full-time**
Kind of subject	**optional-specialization**
Subject code	**W09ENG-SM2362**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	Crediting with grade		Crediting with grade		
For group of courses mark final course with (X)					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BU) classes	0,68		0,76		

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 LEARNING OUTCOMES

relating to knowledge:	
PEU_W01	Has knowledge of rules and standards for design and operation of air-condition systems
PEU_W02	Has 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

Form of classes - lecture		Number of hours
Lec1	Overview of the lecture. Introduction. Air-conditioning processes. Air flow and thermal comfort.	2

Lec2 – Lec7	Air-conditioning processes thermodynamic basics. Humid air properties. Psychrometric diagram. Heating, cooling and dehumidifying. Air mixing. Heating and cooling load calculations. Heating and humidifying systems. Influence of air relative humidity level on energy demand of heating and cooling systems. Refrigeration cycle for air-conditioning. Required temperature levels. Convective and radiant heat loads. Piping connection methods in air-conditioning systems. Heat recovery. Heat exchangers for air-conditioning. Thermal storage systems (cold water, ice slurry, ice harvesting, PCM).	12
Lec8	Colloquium	1
Total hours		15

laboratory		Number of hours
La1 – La7	Thermodynamic changes of moist air inside the air washer; adiabatic cooling. Dehumidification of moist air. Measurements of working parameters of the split air conditioner. Testing the ducted system air conditioning at varying load. Measurements of working parameters of the countercurrent flow recuperative heat exchanger. Measurements of working parameters of the spiral countercurrent flow recuperative heat exchanger. Testing the portable air conditioner	2
La8	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 colloquium.
N4	Office hours.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F– forming (during semester), C– concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
C1	PEU_W01 – PEU_W02	Mark of the colloquium
C2	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)

Name and surname:	Bogusław Białko
E-mail address:	boguslaw.bialko@pwr.edu.pl