STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Air Conditioning and Refrigeration**		Code **1010101261010130289**
Field of study **Environmental Engineering First-cycle Studies**	Profile of study (general academic, practical) **(brak)**	Year /Semester **3 / 6**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **45** Classes: **15** Laboratory: **-** Project/seminars: **30**		No. of credits **5**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences**		ECTS distribution (number and %) **100 5%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Knowledge of mathematics, physics, chemistry and biology, which is the basis for understanding the mathematical transformations and the identification and evaluation of thermal and microbiological areas and devices for air preparation. Knowledge of thermodynamics, heat transfer, fluid mechanics and ventilation - in the field of thermodynamics of moist air, the theory of penetration, conductivity and heat transfer and flow of indoor air and ventilation units.
2	**Skills**	The ability to perform mathematical transformations, derivation of mathematical formulas and solving classic linear equations and differential equations. The ability to perform hydraulic calculations, calculations of heat losses, cooling loads and perform engineering drawings in AutoCAD.
3	**Social competencies**	The student should be aware of the consequences of decisions. The student understands of the need to constantly update and supplement knowledge and skills.

Assumptions and objectives of the course:

-The aim is to gain knowledge and skills in the field of air conditioning and the cooling in buildings in the design processes and technology of those systems and conduct analyzes of pre processes and equipment used in air conditioning installation and performance in this area.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Knowledge of the comfort parameters of the indoor climate, determination of heating and cooling loads for the selection of air-conditioning system - [[K_W01, K_W02, K_W03, K_W04]]

2. Knows the process of the thermodynamic preparation of the air in air devices and air-conditioning (also in the h-x graph) and the basic structure of the air conditioning and cooling systems used in buildings - [[K_W02, K_W04, K_W05, K_W07]]

3. Has knowlege in the selection of air-conditioning units and characteristics of all the components of air-conditioning units, in particular: air filters, heaters, coolers, humidifiers, heat exchangers for heat recovery, fans, chillers, condensers, air conditioners - [[K_W03, K_W04]]

4. Has knowlege of the calculation of aerodynamic air systems, including the determination of pressure loss characteristics of the system, cooperation between fan and duct system and methods of regulating the efficiency of these systems - [[K_W03, K_W04]]

5. Knows the basic distribution systems of air conditioned rooms for central and decentralized systems - [[K_W02, K_W03, K_W04]]

6. The general knowledge of the development of the structure of the air conditioning and cooling system for the room / building - [[K_W02, K_W07]]

7. Knowledge of the basic structure of the control systems of air handling units and air conditioning systems - [[K_W07]]

8. Knows basic programs for the calculation of air conditioning systems - [[K_W07]]

Skills:

1. A graduate student is able to define the comfort parameters of the indoor climate and indoor air quality in air conditioned rooms and is able to calculate heating and cooling loads and supply air stream - [[K_U01, K_U09, K_U16]]

2. Is able to perform calculations in the field of air distribution in order to select diffusers and exhaust units in air conditioning systems - [[K_U01, K_U07, K_U08, K_U09]]

3. Is perform calculations of performance and size of the components in the air handling unit including the efficiency of the equipment for heat recovery from exhaust air and provide interpretation of the calculations in the h-x chart - [[K_U09, K_U16]]

4. Is able to perform aerodynamic calculations for air system, select dimension of air ducts, calculate the pressure losses and the operating point of the fan - [[K_U09, K_U11, K_U16]]

5. Is able to choose the air-conditioning system for the room and the whole building - [[K_U15, K_U16]]

6. Can use device catalogs and choose the device based on charts or programs for final assembly - [[K_U01, K_U02, K_U15, K_U16]]

7. Can do the drawings for the project in AutoCad technology - [[K_U01, K_U02, K_U09, K_U16]]

Social competencies:

1. Is aware of the impact of climate comfort for the well-being of man - [[K_K02, K_K05, K_K07]]

2. Is aware of the need to systematically deepen and broaden their competence - [[K_K01]]

3. Is aware of the importance of conditioning as part of the technical building equipment affecting the health, safety and productivity of man - [[K_K02, K_K05, K_K07]]

Assessment methods of study outcomes

-Lecture:

written exam - duration 90 minutes - computational problem (1 task),

knowledge test (5 questions)

oral exam

Classes:

two tests of knowledge during the semester.

Project:

individual project; Ongoing control of the project during exercise and consultation; a credit of the project on the basis of an oral defense

Course description

-The history of the development of air-conditioning. Concepts definition of air conditioning (differences in relation to ventilation), classifications. External climate parameters. Parameters of climate comfort, including thermal comfort air quality and adaptive comfort. Loads for ventilation and air conditioning: the gain of sensible heat, cooling load, the profits of moisture emissions. Sizing air ducts, lines of pressure. Elements of central air conditioning systems - and calculations: fans, filters, heaters, coolers, humidifiers and dehumidifiers, recuperators, regenerators, dampers, air intakes, launchers, valves, fire dampers. Structures and systems of air conditioning - divisions. Air conditioning using only the air: Single-channel, dual-channel, zonal, with variable air volume (VAV). Mixed systems: the nozzle fan coil, with chilled ceilings. Local air conditioning systems: air conditioners, compact systems, SPLIT, VRV. Systems of energy-saving air conditioners. Regulation and control in air conditioning and refrigeration systems. Adjusting the temperature and humidity, diagrams of basic regulatory systems. Methods of cooling air. The cooling circuits used in air conditioning systems, refrigerants, refrigeration cycles. The compressor cooling circuits and the absorption cooling circuits. Components and equipment of refrigeration systems. Refrigerants and coolants. Chillers for air conditioning. Heat pumps used in air conditioning.

Basic bibliography:

1. Recknagel H., Sprenger E., Schramek E.R.: Kompendium wiedzy: ogrzewnictwo, klimatyzacja, ciepła woda, chłodnictwo, Wydawnictwo Omni Scala, Wrocław 2008

2. Pełech A.: Wentylacja i klimatyzacja - podstawy. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2008.

3. Pełech A., Szczęśniak S.: Wentylacja i klimatyzacja. Zadania z rozwiązaniami i komentarzami. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2012

4. Lipska B.: Projektowanie wentylacji i klimatyzacji. Podstawy uzdatniania powietrza. Wydawnictwo Politechniki Śląskiej Gliwice 2012

5. Malicki M.: Wentylacja i klimatyzacja. PWN Warszawa 1980

6. Jones W.P.: Klimatyzacja. ARKADY. Warszawa 2001

Additional bibliography:

1. Mizieliński B.: Systemy oddymiania budynków. WNT Warszawa 1999.

2. Gaziński B.: Technika klimatyzacyjna dla praktyków. Komfort cieplny, zasady obliczeń i urządzenia. Systherm Serwis. Poznań 2005

3. Baumgarth, Horner, Reeker: Poradnik Klimatyzacji. Tom 1: Podstawy. Wydanie 1 polskie na podstawie 5. zmienionego i rozszerzonego wydania niemieckiego. Systherm, Poznań 2011

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	45
2. Participation in classes	15
3. Participation in project classes	15
4. Participation in consultations related to the implementation of the design	5
5. Implementation of design tutorials (work at home incl. e.g. software installation and software learning)	30
6. Preparing to the exam and presence on it	20

Student's workload

Source of workload	hours	ECTS
Total workload	136	5
Contact hours	93	3
Practical activities	41	2