STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Air-conditioning, ventilation and refrigeration**		Code **1010102221010132039**
Field of study **Environmental Engineering Second-cycle**	Profile of study (general academic, practical) **(brak)**	Year /Semester **1 / 2**
Elective path/specialty **Heating, Air Conditioning and Air Protection**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **30** Classes: **30** Laboratory: **-** Project/seminars: **30**		No. of credits **6**
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 %) **6 100%**

Responsible for subject / lecturer:

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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, air conditioning and refrigeration - in the field of first cycle studies.
2	**Skills**	The ability to perform mathematical transformations, derivation of mathematical formulas and solving classic linear equations and differential equations in the field of heat transfer and hydraulics in air ducts. The ability to perform hydraulic calculations in the field od ventilation, air conditioning and refrigeration 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 in special facilities.

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. Knowlege in designing hydraulic, aerodynamic and acoustic air and refrigeration systems - [[K2_W05, K2_W07]]

6. Knows the rules of location of ventilation, air conditioning and refrigeration units in the structure of the special purpose-facilities - [[K2_W06, K2_W07]]

7. The general knowledge of the development of the structure of the air conditioning and cooling system for special purpose-facilities - [[K_W02, K_W07]]

8. Has knowledge of the basic structure of the control systems of air conditioning systems, control algorithms and economical operation - [[K2_W04, K2_W05]]

9. Knows the principles of design and analysis of fire ventilation systems of - [[K2_W04, K2_W05]]

10. 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 and optimized heating and cooling loads and supply air stream - [[K_U01, K_U09, K_U16]]

2. Is able to perform calculations in hydraulic circuits of heating and cooling systems and aerodynamics of the air systems iin buildings of special purposes - [[K2_U01, K2_U07]]

3. Is able to perform complex calculations of air conditioning systems for any building - [[K2_U07, K2_U09, K2_U11]]

4. Is able to perform pre-analysis including economic and choose the appropriate option of the air conditioning or refrigeration system - [[K2_U07, K2_U08, K2_U11, K2_U14]]

5. Is able to perform acceptance tests of air conditioning systems and their components - [[K2_U08, K2_U11]]

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 air conditioning and refrigeration systems 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

-Rules of cooling in buildings, night cooling, using heat capacity of the building. Solutions of energy-efficient cooling. Integrated heating and cooling systems. Cooling systems of the energy stores (ice, PCM). Solutions for conditioning systems for swimming pools. Clean rooms: range of issues. Classification of cleanrooms. Classes of dust and microbiological purity. The balance of particle pollution. Air distribution systems in cleanrooms. Determination of class of purity. Research and classes of filters for cleanrooms. Structures of conditioning depending on the quality class. Air-conditioning systems for purity class. Passive and active airlocks. The tightness of air conditioning systems and cleanrooms. Ventilation and air conditioning in hospitals. Structure systems for operating rooms. Distribution of air in operating rooms. Fittings for air systems in cleanrooms. Air conditioning costs for cleanrooms. Precision air conditioning. Air conditioning of telephone exchanges and server.Air conditioners specialized for precision air conditioning. Optimization of energy consumption and reliability.

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

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

Additional bibliography:

1. Mizieliński B., Kubicki G.: Wentylacja pożarowa. Oddymianie. WNT Warszawa 2012.

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	30
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	15

Student's workload

Source of workload	hours	ECTS
Total workload	110	6
Contact hours	65	4
Practical activities	45	2