STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Ventilation**			Code **1010101251010130300**
Field of study **Environmental Engineering First-cycle Studies**	Profile of study (general academic, practical) **(brak)**		Year /Semester **3 / 5**
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: **30** Classes: **-** 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 %) **5 100%**

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**	Basic knowledge of mathematics, physics, chemistry and biology as a tool for understanding mathematical transformations and identification as well as assessment of the chemical and microbiological pollutants in air. Basic knowledge of thermodynamics, heat transfer and fluid mechanics in the thermodynamics of moist air, theory of infiltration, conductivity, heat transfer and fluid dynamics.
2	**Skills**	The ability to perform mathematical transformations, derivation of mathematical equations and solving classical regular differential equations. The ability to perform hydraulic calculations, heat loss calculation and making drawings in AutoCAD software.
3	**Social competencies**	Awareness of the need to constantly update and complement knowledge and skills.

Assumptions and objectives of the course:

Expanding knowledge of the theoretical basis and practical solutions of indoor ventilation systems and ventilation devices as well as basis of selection and operation of ventilation systems for variable types of rooms.

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

Knowledge:

1. Student has knowledge about the systematic of widely understood comfort climate, determining of ventilation loads, especially sensible heat gains, moisture gains, pollution and the methods of determining the amount of ventilation air (obtained during the lecture and auditorium exercises) - [K_W01, K_W02, K_W03, K_W04]

2. Student knows the basic structures of mechanical ventilation systems: supply, exhaust, supply-exhaust, including systems with heat recovery from the exhaust air (obtained during the lecture and auditorium exercises) - [K_W02, K_W04, K_W05, K_W07]

3. Student has knowledge about the characteristics of all air handling unit components, especially: air filters, heaters, heat recovery exchangers, fans (obtained during the lecture) - [K_W03, K_W04]

4. Student has knowledge about the aerodynamic calculation of air systems, including pressure losses and system characteristics determination, fan and duct system cooperation as well as efficiency regulation methods of this system (obtained during the lecture and auditorium exercises) - [K_W03, K_W04]

5. Student knows the basic indoor air distribution systems, supply air and exhaust air diffusers (obtained during the lecture) - [K_W02, K_W03, K_W04]

6. Student has the general knowledge about room acoustics as well as acoustic calculation and silencer selection rules (obtained during the lecture) - [K_W02, K_W07]

7. Student knows the mathematic models and natural ventilation solutions of industrial halls, including aeration (obtained during the lecture) - [K_W03, K_W04]

8. Student knows the basic structures of exhaust hoods systems used in industrial ventilation, methods and sizing of them as well as applications (obtained during the lecture and auditorium exercises) - [K_W04, K_W05, K_W07]

Skills:

1. Student can set loads emission, including sensible heat gains and moisture gains calculation as a loads for ventilation system, air volume calculation for determined and undetermined loads emission (obtained on the auditorium and project exercises) - [K_U01, K_U09, K_U16]

2. Student can perform a calculations for the indoor air distribution systems as a tool for supply air and exhaust air diffusers selection (obtained on the project exercises) - [K_U01, K_U07, K_U08, K_U09]

3. Student can perform a heat efficiency calculations for the heater in air handling unit taking into account a heat exchangers efficiency including exhaust air recovery, presenting interpretation of calculations on the h-x graph (obtained on the auditorium and project exercises) - [K_U09, K_U16]

4. Student can perform a aerodynamic calculations of air system, duct sizing, pressure losses calculation as well as calculate set point for fan-duct system structure (obtained on the auditorium and project exercises) - [K_U09, K_U11, K_U16]

5. Student can perform a calculations for exhaust hood, suction nuzzles or covers selection (obtained on the project exercises) - [K_U09, K_U11]

6. Student can use a manufacturers catalogues as well as perform devices selection based on graphs and software (obtained on the project exercises) - [K_U01, K_U02]

7. Student can perform drawings in AutoCAD technique - design (obtained on the project exercises) - [K_U01, K_U02, K_U09, K_U16]

Social competencies:

1. Student is aware of the impact of indoor climate comfort on human well-being (obtained on the auditorium) - [K_K02, K_K05, K_K07]

2. Student can see the need of continuous broadening and enhancement of their competencies (obtained on the auditorium and project exercises) - [K_K01]

3. Student is aware of the importance of ventilation as a part of the technical building equipment affecting the human health and safety (obtained on the auditorium and project exercises) - [K_K02, K_K05, K_K07]

Assessment methods of study outcomes

> Lecture

- written examination (educational results: W01,W02,W02,W04,W05,W07,U01,U09):

duration: 90 min, test of skills (1 task), test of knowledge (8 questions), max. 55 points, admission to the oral exam min. 50% of max. number of points

- oral examination (supplementary questions).

> Design tutorials (educational results: U01,U02,U07,U08,U09,U11,U16):

- individual design; continuous monitoring of implementation of the design during the tutorials and consultations; passing by the oral answers,

- written test from the scope of analytical part of the design (min. 50% of max. number of points).

Course description

Ventilation and air conditioning - definition, classification. Outdoor climate parameters. Climate comfort parameters incl. thermal comfort, Fanger's equation. Indoor air quality: carbon dioxide emission, dust, microbes, aerosols, NDS. Ventilation and air conditioning loads: sensible heat gains, moisture gains, pollutant emissions. Air volume calculation for determined and undetermined loads emissions. Indoor air distribution systems: air stream classification and characteristics, supply air and exhaust air diffusers. Air distribution systems in special rooms. Duct sizing, pressure lines. Elements of air handling unit and ventilation system - calculation and selection: fans, filters, heaters, heat exchangers (recuperators, rotary regenerators), silencers, outdoor air intakes, exhaust air dischargers, dampers, fire dampers. Acoustics of air systems - general issues. Noise sources, own attenuation of the system, acoustic calculation and silencer selection. Natural and mechanical system of ventilation structures. Ventilation systems division in industry. Aeration - mathematic models, technical solutions. Local exhaust - sizing rules of exhaust hoods, suction nuzzles, covers and ducts. Air cleaners in industrial ventilation. Air curtains - classification, sizing, applications. Ventilation systems for various type of industry.

Educational methods: an informative lecture, a lecture with a multimedia presentation, a problem lecture. Design tutorials: presentation of solutions of analytical and design issues, case studies, consultation of individual solutions.

Basic bibliography:

1. W. Stankiewicz, J. Wojtowicz, Zadania z matematyki dla wyższych uczelni technicznych, PWN, część pierwsza i druga, Warszawa.

2. M. Gewert, Z.Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS.

3. I. Foltyńska, Z. Ratajczak, Z. Szafrański, Matematyka część I i II, Wydawnictwo Politechniki Poznańskiej.

4. W. Stankiewicz, J. Wojtowicz, Zadania z matematyki dla wyższych uczelni technicznych, PWN, część pierwsza i druga, Warszawa.

5. M. Gewert, Z.Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS.

6. I. Foltyńska, Z. Ratajczak, Z. Szafrański, Matematyka część I i II, Wydawnictwo Politechniki Poznańskiej.

7. Przydróżny S.: Wentylacja. Wydawnictwo Politechniki Wrocławskiej. Wrocław 1991.

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

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

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

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

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

Additional bibliography:

1. E. Swokowski, Calculus with analytic geometry, Prindle, Weber & Schmidt, Boston, Massachusetts.

2. W. Krysicki, L.Włodarski,Analiza matematyczna w zadaniach, PWN, Warszawa.

3. E. Swokowski, Calculus with analytic geometry, Prindle, Weber & Schmidt, Boston, Massachusetts.

4. W. Krysicki, L.Włodarski,Analiza matematyczna w zadaniach, PWN, Warszawa.

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

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

7. 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 (contact hours)	30
2. Participation in design tutorials (contact hours, independent work)	30
3. Participation in consultations related to the implementation of the design (contact hours)	5
4. Implementation of design tutorials (work at home incl. e.g. software installation and software learning)	40
5. Preparing to the exam and presence on it (contact hours, independent work)	20

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	65	3
Practical activities	20	2