COURSE DESCRIPTION CARD - SYLLABUS

Course name
RENEWABLE HEAT OF THE GROUND IN ENERGY - EFFICIENT VENTILATION SYSTEMS

Course

Proposed by Discipline
Environmental engineering, mining and energy
Type of studies
Doctoral School
Form of study
full-time

Year/Semester
II/3
Course offered in
English
Requirements
elective

Number of hours

Lecture
8

Tutorials

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge: : PhD student has basic knowledge in the field of renewable energy resources, thermodynamic and fluid mechanics.

Skills: PhD student is able to analyze scientific problems using databases and critically evaluate the quality of input data.

Social competencies: PhD student doctoral student is able to consider opinions of other social groups in his/her deliberations and to conduct debates on various aspects related to the conducted research.

Course objective

Presentation of the great importance of ventilation for the energy efficiency of buildings as well as the concept of energy-efficient ventilation systems with the possibility of using a renewable heat source from the ground.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:
1) global achievements, covering theoretical foundations as well as general and selected specific issues that are relevant to energy efficient ventilation of buildings, [P8S_WG/SzD_W01]
2) key developmental trends of disciplines of ventilation and earth-to-air heat exchangers, [P8S_WG/SzD_W02]
3) scientific research methodology in the field of flow-characteristics of earth-to-air heat exchangers, [P8S_WG/SzD_W03]
4) economic, legal, ethical and other vital conditions related to scientific activity in the field of energy efficient ventilation systems and earth-to-air heat exchnagers, [P8S_WK/SzD_W06].

Skills

A PhD student who graduated from doctoral school can:
1) use knowledge from different branches of science to creatively identify, formulate and innovatively solve complex problems or to perform research tasks such as:
- define the aim and subject of scientific research, form a research hypothesis,
- develop research methods, techniques and tools and use them creatively,
- draw conclusions on the basis of research results, [P8S_UW/SzD_U01]
2) critically analyze and assess scientific research results, work of experts and other creative activities together with their contribution into knowledge development, [P8S_UW/SzD_U02]
3) communicate on specialist issues on the level that allows active participation in the international scientific community, [P8S_UK/SzD_U04]
4) share results of scientific activity also in a popular form, [P8S_UK/SzD_U05]
5) initiate debates, [P8S_UK/SzD_U06].

Social competencies

A PhD student who graduated from doctoral school is ready to:

1) critically assess achievements within a given scientific discipline, [P8S_KK/SzD_K01]

2) critically evaluate their own contribution to development of a given scientific discipline, [P8S_KK/SzD_K02]

3) acknowledge the importance of knowledge in solving cognitive and practical problems, [P8S_KK/SzD_K03]

4) initiate actions in the public interests, [P8S_KO/SzD_K05]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01, W02, W03, W06	Written exam covering the verification of theoretical knowledge from the lectures.	pass rate 50%
U01, U02, U04, U05, U06	Written exam covering the verification of theoretical knowledge from the lectures.	pass rate 50%
K01, K02, K03, K05	Written exam covering the verification of theoretical knowledge from the lectures.	pass rate 50%

Programme content

1. Introduction to the issue of energy-efficient buildings.
2. Presentation of great importance of ventilation for the energy efficiency of buildings.
3. Discussions about requirements for concept of energy-efficient ventilation systems.
4. Possibility of using a renewable heat source from the ground.
5. Earth-to-air heat exchangers – presentation of the system.
6. Experimental and numerical investigations of earth-to-air heat exchangers flow characteristics.
7. Procedure for calculating the energy delivered by earth-to-air heat exchangers.
8. Discussion about cost of using renewable heat from the ground. Economic, legal, ethical and other vital issues related to energy-efficient ventilation systems.

Course topics

1. Introduction to the issue of energy-efficient buildings.
2. Energy efficient ventilation systems.
3. Earth-to-air heat exchangers.

4. Economic, legal, ethical and other vital issues related to energy-efficient ventilation systems.

Teaching methods

Lecture: multimedia presentation including illustrations and examples.

Bibliography

Basic

[1] Amanowicz Ł., Ratajczak K., Dudkiewicz E., Recent Advancements in Ventilation Systems Used to Decrease Energy Consumption in Buildings - Literature Review, Energies 2023, 16, 1853, https://doi.org/10.3390/en16041853

[2] Amanowicz Ł., Influence of geometrical parameters on the flow characteristics of multi-pipe earth-to-air heat exchangers – experimental and CFD investigations, Applied Energy (226) 2018, 849-861 https://doi.org/10.1016/j.apenergy.2018.05.096

[3] Amanowicz Ł., Wojtkowiak J., Thermal performance of multi-pipe earth-to-air heat exchangers considering the non-uniform distribution of air between parallel pipes, Geothermics 88, 2020, 101896, https://doi.org/10.1016/j.geothermics.2020.101896

[4] Amanowicz Ł., Wojtkowiak J., Comparison of Single- and Multipipe Earth-to-Air Heat Exchangers in Terms of Energy Gains and Electricity Consumption: A Case Study for the Temperate Climate of Central Europe, Energies 2021, 14, 8217, https://doi.org/10.3390/en14248217

Additional

[1] Amanowicz Ł., Wojtkowiak J., Approximated flow characteristics of multi-pipe earth-to-air heat exchangers for thermal analysis under variable airflow conditions, Renewable Energy 158C (2020), 585-597, https://doi.org/10.1016/j.renene.2020.05.125

[2] Amanowicz Ł., Wojtkowiak J., Validation of CFD model for simulation of multi-pipe earth-to-air heat exchangers (EAHEs) flow performance, Thermal Science and Engineering Progress, Vol. 5 2018, 44-49, https://doi.org/10.1016/j.tsep.2017.10.018

[3] Ratajczak, K.; Amanowicz, Ł.; Pałaszyńska, K.; Pawlak, F.; Sinacka, J. Recent Achievements in Research on Thermal Comfort and Ventilation in the Aspect of Providing People with Appropriate Conditions in Different Types of Buildings—Semi-Systematic Review. Energies 2023, 16, 6254, https://doi.org/10.3390/en16176254

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	8	0
Doctoral student's own work (literature studies, preparations for exam) [1]	42	2,0

[1] delete or add other activities as appropriate