COURSE DESCRIPTION CARD - SYLLABUS

Course name
Heating Systems

Course

Field of study
Environmental Engineering Second-cycle Studies

Year/Semester
1/2

Area of study (specialization)
Heating, Air Conditioning and Air Protection

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
20		
Tutorials	**Projects/seminars**	
10	18	

Number of credit points

5

Lecturers

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

1.Knowledge:

Basics of heat and fluid mechanics, heating - at level 6 of NQF. The student knows basic relationships describing heat transfer and heating medium flow in a steady state under nominal operating conditions, for typical elements of water and air heating systems.

2.Skills:
The student is able to formulate and solve mass and energy balances for simple systems, under steady-state conditions as well as convert units of physical quantities related to heat transfer and fluid mechanics.

3.Social competencies
Awareness of the need to constantly update and supplement knowledge and skills.

Course objective

Extending and deepening the knowledge and skills in: design, field tests and simulation analysis of complex heating systems.

Course-related learning outcomes

Knowledge

1. The student has structured and theoretically founded knowledge of the differential pressure regulator action (hydraulic stabilization systems action) and its impact on the hydraulics of the heating system and knows the structure and elements of large heating systems and principles of adjusting the heating system to the specific building.
2. The student understands balancing of the energy, weight, heat power and mass flow in unusual patterns of heating systems and for heating systems working under partial load.
3. The student has structured and theoretically founded knowledge on issues related to the design of central heating and knows methods of design and installation of floor and wall heating systems.
4. The student has structured knowledge on developments in the area connected with heating systems.
5. The student knows the calculation methods, design techniques, tools and materials used in solving engineering tasks related to the design of heating systems for large residential buildings as well as various utility functions.

Skills

1. The student can perform thermal - hydraulic calculations for complex, multi-zone heating systems, including panel heating.]
2. The student can compare the efficiency of different heating systems for ensuring the level of thermal comfort and energy consumption.
3. The student can use computer's program for central heating design in order to analyse and critically evaluate the calculations results as well as process the technical documentation in electronic form.
4. The student can apply known relationships (e.g. energy balances) to solve atypical problems in heating systems.
5. The student knows how to balance the hydraulic systems of large buildings, and how to account for thermal expansion of pipes in the design of heating systems.

Social competences

1. The student understands the need for teamwork in solving theoretical and practical problems.
2. The student is aware of the importance and understands the effects of engineering activities, including their impact on the environment.
3. The student sees the need for systematic extending their competences.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:
Lecture (pass from 51%):
Written examination, in doubtful cases followed by an oral examination.
Final evaluation of the exam takes into account the result of the test and grades earned for the tutorials and project.
Tutorial:
1 written final test
Continuous assessment at each class (rewarding the activity).

or continuous assessment after each class by solving the tasks containing individual data and submitting them to the teacher via an electronic form in Google Docs.
Project Classes:
design of a complex multi - zone heating system for a multi-family building with differing utility functions using professional computing packages and selfmade spreadsheet software.
Oral defense of the project. Additional mark as a reward for regular and timely participation. Continuous assessment at each class (rewarding the activity).

Programme content

1. Computer programs related to computer-aided design of water heating: general structure, computing capabilities, available catalogs, ways of entering data, available software, capabilities to analyze and critically evaluate the results of calculations in computer programs, processing technical documentation in electronic form.
2. Hydraulic regulation of large central heating installations.
3. Thermal elongation of pipes in the design of water heating installations
4. Panel and radiant heating systems: floor heating, wall and ceiling heating, radiant strip heaters, infrared radiators. Issues of thermal comfort, basic parameters and limits for panel and radiant heating systems. Solutions and basic requirements for floor heating. Design principles for floor heating: general, thermal and hydraulic. Hydraulic systems and output regulation of panel heating. Applied automation. Mixed heating: panel - radiator - options for cooperation. Wall heating - solutions and basic work parameters. Radiant heating in rooms with high volume - the basics of heat transfer by radiation, example solutions, specifics of heat power demand calculation for heated spaces with the use of gas and electric heaters. Heating solutions for open spaces. Principles of sizing and operation. Thermal activation of ceilings cores - examples of use for heating and cooling. Warm air heating: systems, basic sizing, applicable heat sources, heat recovery and ground heat exchangers. Warm air heating solutions for low - energy buildings.
5. Use of heat pumps in heating. Selection of heat sources for pumps water - water and air - water. Cooperation systems of heat pumps with additional heat sources: monovalent and bivalent systems. Collaboration diagrams and variability charts for heat loads. Control of the heat pump heating power. Selection of the buffer tank. Use of heat pumps for warm water systems. Errors in connecting the hot water storage cylinder. Basic tasks of heat pump controller. Combination of heat pumps and installations for obtaining low-temperature heat.

Teaching methods

Informative lecture with seminar elements, lecture with multimedia presentation
exercise method,
individual project - case study

Bibliography

Basic

11. Koczyk H., Antoniewicz B., Basińska M., Górka A., Makowska-Hess R.: Ogrzewnictwo Praktyczne projektowanie, montaż, certyfikacja energetyczna, eksploatacja Systherm Serwis, Poznań 2009
2. Chwieduk D.: Energetyka słoneczna budynku Arkady Warszawa 2011
3. Laskowski L.: Ochrona cieplna i charakterystyka energetyczna budynku. Oficyna Wydawnicza

Politechniki Warszawskiej. Warszawa 2005r
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7. Mizielińska K., Olszak J.: Parowe źródła ciepła WNT 2009
8. Pyrkov V., Regulacja hydrauliczna systemów ogrzewania i chłodzenia. _Teoria i praktyka, Wyd. Systherm, Poznań, 2007
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11. Rabjasz R., Dzierzgowski M.: Ogrzewanie podłogowe. Poradnik. COIB Warszawa 1995

Additional

1. ASHRAE Handbook - Fundamentals, Atlanta, 2013
2. ASHRAE Handbook - HVAC Systems and Equipment, Atlanta, 2016
3. ASHRAE Handbook - HVAC Applications, Atlanta, 2015
4. Mańkowski S. - Projektowanie instalacji ciepłej wody użytkowej, Arkady, Warszawa, 1981
5. Czasopisma: Ciepłownictwo Ogrzewnictwo Wentylacja, Rynek Instalacyjny, Instal - Teoria i Praktyka w Instalacjach, Cyrkulacje, InstalReporter, Energy and Building
6. Hensen J.L.M., Lamberts R. (red) Building Performance Simulation for Design and Operation, Son Press 2011

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,0
Classes requiring direct contact with the teacher	48	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, additional homework prescribed by the teacher) [1]	77	3,0

[1] delete or add other activities as appropriate