COURSE DESCRIPTION CARD - SYLLABUS

Course name
Heating Systems II [N2IŚrod1-ZwCKiOP>SII]

Course

Field of study
Environmental Engineering

Year/Semester
2/3

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

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
10

Laboratory classes
0

Other (e.g. online)
0

Tutorials
8

Projects/seminars
18

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

1.Knowledge: Basics of thermal engineering and fluid mechanics, heating - level I°. The student has a structured, theoretically founded basic knowledge of issues related to the design of central heating systems. 2.Skills: Basics of thermal engineering and fluid mechanics: solving problems and making measurements at level 6 of NQF. The student is able to formulate and solve mass and energy balances for simple systems, under steady- state conditions as well as convert the units of physical quantities for heat transfer and fluid mechanics problems. The student can operate basic computer programs: CAD, Excel, Word 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 the scope of design, operation and simulation analysis of complex heating systems, including the use of renewable energy sources

Course-related learning outcomes

Knowledge:
1. The student has structured and theoretically founded knowledge of the methods for assessing the energy

consumption in a building.
2. The student has structured knowledge of developments in the area connected with heating systems and possible applications of low-temperature heat sources.
3. The student knows the structure and elements of heating and hot water systems cooperating with renewable energy sources related to the building energy needs standard and has expanded and theoretically
founded knowledge of the possibilities of using solar thermal collectors in heating and hot water systems
4. The student knows the methods of calculation and simulation, tools and materials used in solving the engineering tasks related to design of heating and hot water systems cooperating with renewable energy sources and knows the methods of assessment for buildings and energy installations during life cycle as well
as methods of assessment of energy and economic efficiency for thermomodernization.
5. The student knows the areas of application and performance parameters for thermographic cameras and the effect of surface emissivity on thermographic measurement results and knows the impact of the lack of airtightness on the effective heat recovery efficiency of an air heating system

Skills:
1. The student can formulate a concept and design solutions for heating and hot water systems using renewable energy sources, including selection of
2. The student is able to perform an energy ecological evaluation of a self-designed complex installation system.
3. The student can use a Minneapolis Blower Door device as well as specialized software in order to measure the air tightness of a room.
4. The student knows how to operate the thermographic camera, use specialized software for thermal imaging, interpret and evaluate the thermal images, assess the condition of pipe insulation and building insulation on the basis of thermal images.

Social competences:
1. The student understands the need for teamwork in solving theoretical and practical problems.
2. The student is aware of the need to reiterate the steps of measuring and evaluating the uncertainty of the results of measurements and calculations.
3. The student sees the need for systematic deepening and 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: (pass from 51%)
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 heating and hot water system using renewable energy sources, prepared with the use of
professional computing packages and individual spreadsheets software.
Oral defense of the project. Additional mark as a reward for regular and timely participation. Continuous assessment at each class (rewarding the activity).
Laboratory exercises: the so-called input tests development and individual defense of reports

Programme content

1. Use of solar energy for domestic hot water and heating systems of buildings.
2. Active systems for direct and indirect use of solar energy.
3. Construction of a flat plate and vacuum solar collectors. Technological characteristics of solar collector components.
4. The equation for the efficiency of a solar collector. Temporary and long-term efficiencies of the solar

collector.
5. Air solar collectors - characteristics and examples of solutions.
6. Diagrams of solar thermal systems. Criteria for small and large solar installations.
7. Design principles for small solar installations. Types of solar storage tanks. Examples of solutions and components of solar installations for domestic hot water preparation.
8. Large solar installations for the purpose of heating and hot water systems, with buffers and the charging and discharging exchangers. Principles of design and operation. Design of solar collectors? fields. Situating
and connecting collectors. Determination of flow rate, the dimensioning and selection of solar circuit pumps. Stagnation in solar systems. System pressure and emergency coolers. Determination of steam range. Selection of a cooling vessel. Character of selection of the expansion vessel for solar installations.
9. F-chart method for the analysis of the effectiveness of a solar thermal system for heating and domestic hot water purposes.
10. Energy balance of a window and envelope with transparent insulation.
11. Energy efficiency of system of direct and indirect gains.
12. Heating and ventilation systems cooperating with renewable energy sources.
13. Cooperation between heating, ventilation and air- conditioning systems, fan coil units.
14. Photovoltaic cells - correlation of energy supply / consumption in the photovoltaic / heat pump system.
15. Thermal energy storage for heating systems. Selection of materials for energy storage. Examples of long – term battery solutions and rules of their choice. Examples of cooperation solutions for long - term energy storage with the heating system.
16. Determination of annual operational costs of heating and hot water systems. Replacement and upgrade of installations in buildings, their energy and economic efficiencies.

Teaching methods

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

Bibliography

Basic:
1. Chwieduk D.: Energetyka słoneczna budynku Arkady Warszawa 2011
2. Foit H.: Zastosowanie odnawialnych źródeł ciepła w ogrzewnictwie i wentylacji Wydawnictwo Politechniki Śląskiej Gliwice 2010
3. Koczyk H., Antoniewicz B., Basińska M., Górka A., Makowska-Hess R.: Ogrzewnictwo Praktyczne projektowanie, montaż, certyfikacja energetyczna, eksploatacja Systherm Serwis, Poznań 2009
4. Laskowski L.: Ochrona cieplna i charakterystyka energetyczna budynku. Oficyna Wydawnicza Politechniki
Warszawskiej. Warszawa 2005r
5. Mizielińska K., Olszak J.: Parowe źródła ciepła. WNT 2009.
6. Recknagel, Schramek, Sprenger, Honmann: Kompendium wiedzy OGRZEWNICTWO, KLIMATYZACJA, CIEPŁA WODA, CHŁODNICTWO 08/09 OMNI SCALA, Wrocław, 2008
7. Rubik M. : Pompy ciepła Poradnik Ośrodek Informacji Technika Instalacyjna w Budownictwie, Warszawa,
20063.

Additional:
1. Duffie J.A., Beckman W.A.: Solar Engineering of Thermal Processes John Wiley Sons, Inc., New York 1991
2. Hensen J.L.M., Lamberts R. (red) Building Performance Simulation for Design and Operation, Son Press 2011
3. Nowak H.: Zastosowanie badań termowizyjnych w budownictwie Oficyna Wydawnicza Politechniki Wrocławskiej Wrocław 2012
4. Smolec W.: Fototermiczna konwersja energii słonecznej, PWN, Warszawa 2000

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	36	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	64	2,50