STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Heating Systems**		Code **1010102211010132038**
Field of study **Environmental Engineering Second-cycle**	Profile of study (general academic, practical) **general academic**	Year /Semester **1 / 1**
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: **15** Laboratory: **-** Project/seminars: **30**		No. of credits **6**
Status of the course in the study program (Basic, major, other) **other**	(university-wide, from another field) **university-wide**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **6 100%** **6 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

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.

Assumptions and objectives of the course:

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

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

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. - [-]
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 knows the structure and elements of large heating systems and principles of adjusting the heating system to the specific building. - [-]
4. The student has structured and theoretically founded knowledge on issues related to the design of central heating. - [-]
5. The student knows methods of design and installation of floor and wall heating systems. - [-]
6. The student has structured knowledge on developments in the area connected with heating systems. - [-]
7. 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. - [-]
8. The student has knowledge of hydraulic control techniques used in large buildings and methods of compensation for thermal expansion. - [-]

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 Instalsoft program for central heating design in order to analyse and critically evaluate the results of computer program calculations 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 competencies:

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. - [-]

Assessment methods of study outcomes

Lecture

?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 recitation and design exercises.

Recitation classes

? 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).

Course description

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. 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. Use of heat pumps in heating. Types of heat pumps. Applied lower heat sources and their characteristics. The combination of heat pumps with installations for obtaining low - temperature heat. Simplified rules for sizing of ground collectors. Design and installation of geothermal probes. Selection of an appropriate expansion vessel for the ground heat exchanger circuit. 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.

Basic bibliography:

1. Koczyk H., Antoniewicz B., Basińska M., Górka A., Makowska-Hess R.: Ogrzewnictwo Praktyczne projektowanie, montaż, certyfikacja energetyczna, eksploatacja Systherm Serwis, Poznań 2009

2. Laskowski L.: Ochrona cieplna i charakterystyka energetyczna budynku. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2005r.

3. Rabjasz R., Dzierzgowski M.: Ogrzewanie podłogowe. Poradnik. COIB Warszawa 1995

4. Recknagel, Schramek, Sprenger, Honmann: Kompendium wiedzy OGRZEWNICTWO, KLIMATYZACJA, CIEPŁA WODA, CHŁODNICTWO 08/09 OMNI SCALA, Wrocław, 2008

5. Rubik M. : Pompy ciepła Poradnik Ośrodek Informacji Technika Instalacyjna w Budownictwie, Warszawa, 2006

Additional bibliography:

1. Mizielińska K., Olszak J.: Gazowe i olejowe źródła ciepła małej mocy. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2005r
2. Hauke W.(red) RWE Energie BAU ? Handbuch Wyd. RWE AG Essen 1998
3. Klemm P. (red.): Budownictwo ogólne tom II. Wydawnictwo Arkady 2005

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in ex. auditorium	30
3. Participation in projects	30
4. Preparation to ex. auditorium	15
5. Preparation to attend and pass the exam	30
6. Participation in the consultation	5
7. Project realisation	32

Student's workload

Source of workload	hours	ECTS
Total workload	159	6
Contact hours	82	3
Practical activities	45	2