STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Renewable sources of energy in heating		**1010101251010137723**
Field of study	Profile of study (general academic, practical)	Year /Semester
Environmental Engineering First-cycle Studies	**(brak)**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**elective**
Cycle of study:	Form of study (full-time,part-time)	
First-cycle studies	**full-time**	
No. of hours		No. of credits
Lecture: **15** Classes: **15** Laboratory: **-** Project/seminars: **-**		**4**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
(brak)	**(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)
technical sciences		**4 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Knowledge of selected issues in physics, chemistry and biology. Basic principles and laws in the field of technical thermodynamics, heat exchange and fluid mechanics.
2	**Skills**	Application of known laws and relationships to explain phenomena occurring in equipment converting energy from renewable sources. Designation of indicators for assessing the energy and economic efficiency of systems using renewable energy sources.
3	**Social competencies**	Be aware of the need to continually update and refine your knowledge and skills. Exchange of experience with design and execution entities

Assumptions and objectives of the course:

To acquire knowledge and skills in system design and selection of renewable energy sources for practical applications in heating and hot water heating systems.

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

Knowledge:

1. The student has an organized and theoretical knowledge of physics, chemistry, biology, thermodynamics and other fields of environmental engineering to formulate and solve complex environmental engineering tasks - [[K_W01]]
2. The student has an organized and theoretical knowledge of the possibilities of obtaining energy from renewable energy sources - [[K_W05]]
3. The student has a structured knowledge of the construction, operation principles and methods of energy conversion in the devices for its acquisition - [[K_W05]]
4. The student has an orderly and detailed knowledge of the life cycle of equipment, facilities and technical systems used in environmental engineering - solar collectors, heat pumps, geothermal water, biomass - [[K_W06]]
5. Student knows basic methods, techniques, tools and materials used in energy technologies based on non-renewable and renewable primary energy carriers - [[K_W07]]
6. Student knows the general principles of creating and developing forms of individual entrepreneurship, using knowledge of environmental engineering - [[K_W11]]

Skills:

1. Student can acquire, analyze and appropriately use information from Polish and foreign literature on renewable energy sources - [[K_U01]]
2. The student is able to calculate, design and select a system to obtain energy from unconventional sources - [[K_U07, K_U08]]
3. Student can compare the energy efficiency of various devices and systems to obtain energy from unconventional sources - [[K_U11, K_U12]]
4. The student is able to perform a preliminary economic analysis of the undertaken engineering activities with respect to renewable and non-renewable primary energy sources for heating systems and hot water heating - [[K_U14]]
Social competencies:
1. The student sees the need to systematically deepen and broaden their competences - [[K_K01]]
2. The student is able to cooperate in the group, taking in various functions - [[K_K03]]
3. Student is aware of the importance and effects of engineering activities, including its impact on the environment - [[K_K02]]

Assessment methods of study outcomes
Lecture:
Written test of the lecture
exercises:
Final test of exercises
Evaluation of activity on exercises
Course description
Conventional and unconventional energy sources - definitions and types
Solar energy: types of solar collectors, construction and operation of flat and vacuum collectors, collector selection calculations, solutions for hot water heating systems using collectors as heat sources in a bivalent system.
Compressor heat pump: schematic and principle of operation, types of lower heat sources, design calculations of the selection of different heat sources, solutions of heating systems with heat pumps as heat sources in bivalent systems.
Geothermal energy: ways of using geothermal sources, geothermal heating as a source of heating and hot water heating systems, heating solutions using geothermal energy
Biomass: methods of energetic use of biomass, devices and installations for pellet and straw combustion, examples of heating solutions using biomass-fired equipment - pellets, straw, biogas
Subject of the auditorium exercises:
Computational tasks related to lecture topics and design basics.
Basic bibliography:
1. Lewandowski Witold M., Proekologiczne odnawialne źródła energii, Wydawnictwa Naukowo-Techniczne Warszawa 2007
2. Foit Henryk, Zastosowanie odnawialnych źródeł ciepła w ogrzewnictwie i wentylacji, Wydawnictwo Politechniki Śląskiej Gliwice 2010
3. Rubik Marian, Pompy ciepła w systemach geotermii niskotemperaturowej, MULTICO Oficyna Wydawnicza Warszawa 2015
4. Wiśniewski Grzegorz , Kolektory słoneczne. Poradnik wykorzystania energii słonecznej, Wydawnictwo: centralny Ośrodek Informacji Budownictwa, Warszawa 1992
5. Klugmann-Radziemska Ewa, Odnawialne źródła energii. Przykłady obliczeniowe, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2009
Additional bibliography:
1. Kusto Zdzisław, Współpraca pomp ciepła ze źródłem konwencjonalnym. Algorytmy obliczania bilansu energetycznego i efektywności ekonomicznej, Wydawnictwo Gdańskiej Wyższej Szkoły Administracji, Gdańsk 2009
2. Nowak W., Stachel A.A., Borsukiewicz-Gozdur A., Zastosowania odnawialnych źródeł energii, Wydawnictwo Uczelniane Politechniki Szczecińskiej Szczecin 2008

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	15
2. Participate in exercises	15
3. Preparation for the final test of lectures	25
4. Preparation for the final test of the exercises	25
5. Consultation with trainers	5
6. Refill knowledge from magazines, the internet	15

Student’s workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	30	1
Practical activities	70	3