STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Optimization in systems with RES**		Code **1010312431010328892**
Field of study **Power Engineering**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 3**
Elective path/specialty **Sustainable Development of Power**	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: **-** Laboratory: **15** Project/seminars: **15**		No. of credits **5**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **5 100%** **5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge of mathematics, computer science, and courses at second-cycle studies in the direction of power engineering.
2	**Skills**	The ability of use the spreadsheet, high-level programming. The ability of algorithmic thinking.
3	**Social competencies**	Awareness of the need to expand their competence. Readiness to cooperate in the teams. Verbal communication.

Assumptions and objectives of the course:

Knowing the theoretical and practical issues related to the optimization in the field of renewable energy sources. Acquiring the skill selection of optimization methods to the problem. Acquiring the ability to take into account economic aspects in the process of optimization.

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

Knowledge:

1. Has expertise in the design of optimal construction of RES systems. - [KW_18+++]
2. Has the knowledge to take into account aspects of energy security in the optimization of structures RES. - [KW_15+]

Skills:

1. Able to use optimization methods in supporting decisions related to the design of renewable energy systems. - [KU_09+]
2. Able to take into account in the process of optimizing the basic economic indicators. - [KU_13+]

Social competencies:

1. Understands the need for optimal solutions of RES systems . - [KK_01++]

Assessment methods of study outcomes

Lecture:

- Assess the knowledge and skills shown on the written test of character combined: test and problematic.

Laboratory and design:

- Checking preparation for classes,
- Rewarding practical knowledge gained during previous laboratory,
- Assess the knowledge and skills related to the implementation of renewable energy systems optimization methods,
- Rewarding systematic progress in the design,
- Assessment of the form and content of the completed project.

Get extra points for the activity in the classroom, and in particular for:

- Ability to work within a team practically performing the task detailed in the lab,
- Use elements and techniques beyond the material scope of the lecture and project exercises and laboratory.

Course description

Introduction to optimization (definition, classification methods, the objective function, role limitations and methods for taking them into consideration). Discussion of the basic deterministic methods (non-gradient and gradient) and deterministic (Monte Carlo, simulated annealing, evolutionary strategies, genetic algorithm, ant algorithm). The versatility of the method of genetic algorithm. Characteristics and application of multi-criteria methods. Analysis of examples of optimization tasks in the field of renewable energy systems (photovoltaic panels, solar farms, wind turbines and wind farms, hybrid systems, other systems RES). Analysis of the advisability of the use of energy storage systems in optimal RES. Technical and economic aspects of the objective function in the optimization of sample tasks.

Update 2017:

Matlab environment.

Applied methods of education:

lectures - with multimedia presentations (drawings, photographs, animations) supplemented by examples given on the board, run in an interactive way, with questions to students or specific students, presenting a new topic preceded by a reminder of related content known to students from other subjects;

laboratories - supplemented with multimedia presentations, use of tools enabling students to perform home tasks (open source software), demonstrations;

Project - analysis and discussion of various solutions to the problem, multimedia demonstration, teamwork.

Basic bibliography:

1. Trojanowski K.: Metaheurystyki praktycznie, WSISiZ, Warszawa 2008.

2. Stachurski A.: Wierzbicki A. P., Podstawy optymalizacji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001

3. Arabas J.: Wykłady z algorytmów ewolucyjnych, Wydawnictwo Naukowo-Techniczne, Warszawa, 2004.

4. Banasiak K.:Algorytmizacja i programowanie w Matlabie, Wydawnictwo BTC, Legionowo 2017.

5. Odnawialne i niekonwencjonalne źródła energii. Poradnik, Praca zbiorowa pod red. M. Gałuszak, J. Paruch, Wyd. TARBONUS, Tarnobrzeg, 2008.

6. Jajczyk J., Kasprzyk L., Tomczewski A.: Dobór turbiny wiatrowej do lokalizacji geograficznej z wykorzystaniem metod optymalizacji, Przegląd Naukowo-Metodyczny, Edukacja dla Bezpieczeństwa, 2016, nr 1, s. 1200-1211.

7. Jajczyk J.: Use of Personal Computers with Multi-core Processors for Optimisation Using the Genetic Algorithm Method, Proceedings of CPEE 2016, IEEEXplore Electronic ISBN: 978-1-5090-2800-9

Additional bibliography:

1. Michalewicz Z.: Algorytmy genetyczne + struktury danych = programy ewolucyjne, WNT, Warszawa 2003.

2. Stadnicki J.: Teoria i praktyka rozwiązywania zadań optymalizacji - z przykładami zastosowań technicznych, WNT, Warszawa 2006

3. Jajczyk J.: Kamiński R.: Analiza sposobów zasilania odbiorcy pracującego w systemie autonomicznym za pomocą turbiny wiatrowej, Monografia z cyklu Europejski wymiar bezpieczeństwa energetycznego a ochrona środowiska ? tom II, Wojskowa Akademia Techniczna, Poznań 2015, s. 129-139.

4. Jajczyk J.: Optimisation using a parallelised genetic algorithm on a personal computer, Przegląd Elektrotechniczny, R. 91 NR 7/2015, s. 36-38.

Result of average student's workload

Activity	Time (working hours)

1. Participation in class lectures	30
2. Participation in project activities	15
3. Participation in laboratory classes	15
4. Participation in the consultations on the lecture	5
5. Participation in the consultation on the design	5
6. Participation in the consultations on the lab	5
7. Preparation for the design classes	10
8. Preparation for laboratory classes	10
9. Homework preparation	10
10. Prepare for the exam	20
11. Implementation of the final project	20
12. Participation in the exam	5

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	150	5
Contact hours	80	3
Practical activities	90	3