COURSE DESCRIPTION CARD - SYLLABUS

Course name

Optimization in systems with RES

Course

Field of study	Year/Semester
Power Engineering	2/3
Area of study (specialization)	Profile of study
–	general academic
Level of study	Course offered in
Second-cycle studies	polish
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	15	0
Tutorials	Projects/seminars	
0	15	

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

dr inż. Jarosław Jajczyk

email: Jaroslaw.Jajczyk@put.poznan.pl

tel. 616652659

Wydział Automatyki, Robotyki i Elektrotechniki

ul. Piotrowo 3A, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

A student starting this subject should have basic knowledge in mathematics, computer science and subjects taught in second degree studies in the field of energy. You should also have the ability to use a spreadsheet, algorithmic thinking and high level programming.

Course objective

Providing students with theoretical knowledge and practical skills related to solving issues related to optimization in the field of renewable energy sources. Developing the ability to choose the optimization method for an issue, including economic aspects in the optimization process.

Course-related learning outcomes

Knowledge

1. Has knowledge in the field of designing optimal constructions of renewable energy systems.

2. Has knowledge that makes it possible to include aspects of energy security in the optimization of renewable energy structures.

Skills

1. Is able to use optimization methods in supporting decisions related to the construction of renewable energy systems.

2. Is able to include basic economic indicators in the optimization process.

Social competences

1. Understands the need to use optimal solutions for RES systems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired as part of the lecture is verified on the written credit, which consists of 5-7 questions. Passing threshold: 50% of points. The issues on the basis of which questions are prepared will be sent to students by e-mail using the university e-mail system.

Skills acquired during laboratory classes are verified based on small tasks performed at the end of each laboratory class.

Knowledge and skills acquired as part of the project classes are verified based on the project carried out in groups. Division into groups and project topics are determined in the first class.

Programme content

Lecture: Introduction to optimization (division of methods, objective function, role of limitations and methods of their inclusion). Discussion of the basic deterministic (gradientless and gradient) and non-deterministic methods (Monte Carlo, simulated annealing, evolutionary strategies, genetic algorithm, ant algorithm). Characteristics and application of multi-criteria methods. Analysis of sample optimization tasks in the field of renewable energy systems. Technical and economic aspects of the objective function in optimizing sample tasks.

Laboratory exercises: Introduction to ocatve programming. Presentation of the Newton-Raphson method and its use to create a model of a photovoltaic module. Overview of gradient optimization methods. Discussion of approximation issues on the example of a wind turbine power curve. Discussion of the LCOE energy cost model. Overview of the basic genetic algorithm.

Design classes: Based on the knowledge gained during lectures and laboratory classes, students must solve in groups a certain optimization problem (on topics related to renewable energy). During each class, groups presents what they have already done, what their future plans are, what caused them a problem. The lecturer during the presentation leads students to solve encountered problems.

Teaching methods

Lecture: multimedia presentations (drawings, photos, animations) supplemented with examples given on the board and using advanced programming environments, conducted in an interactive way, initiating discussions during the lecture.

Laboratory exercises: multimedia presentations (drawings, photos, animations) introducing the topics of each classes, functions and scripts performed simultaneously with students in the Octave program.

Design classes: a materials describing the task and its scoring, group work, independent creation of a work plan, systematic performance of works, reporting on the current state of work, independent performance of optimization and report summarizing results.

Bibliography

Basic

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. Gałusza, 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

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.

5. Mikulski S., Tomczewski A.: Ocena metod wyznaczania współczynników rozkłądu weibulla w zagadnieniach energetyki wiatrowej, Academic Journals Poznan University of Technology Electrical Engineering vol. 87, Poznań, 2016, pp. 119-127

Breakdown of average student's workload

	Hours	ECTS
Total workload	136	5,0
Classes requiring direct contact with the teacher	76	3,0
Student's own work (literature studies, preparation for laboratory classes, preparation for project classes, preparation for passing) [1]	60	2,0

[1] delete or add other activities as appropriate