# POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

## COURSE DESCRIPTION CARD - SYLLABUS

Course name
Optimization [S2EJ1>Opt]

### Course

Field of study
Nuclear Power Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

### Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

### Number of credit points

4,00

### Coordinators

mgr inż. Marcin Stasiak
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### Lecturers

### Prerequisites

Calculus, linear algebra, basic numerical methods and basic numerical linear algebra

### Course objective

The main aim of the subject is mastering by a student basic knowledge and skills out of scope of gradient and non-gradient optimization methods.

### Course-related learning outcomes

Knowledge:
Has broadened and in-depth knowledge in selected areas of mathematics, including elements of discrete and applied mathematics and optimization, necessary for modeling and analyzing the operation of advanced devices and energy systems and their synthesis. He has extensive knowledge in the use of mathematical models, numerical methods and computer-aided calculation systems to solve complex technical issues in the energy industry, including nuclear energy.

Skills:
Is able to apply and modify mathematical models in the analysis and design of processes, devices and

energy systems in normal and emergency operating states of the power system.
Is able to use numerical and simulation methods as well as IT tools to design and analyze the operation of energy systems, including individual elements of nuclear power plants

Social competences:
Is able to think and act in a creative and entrepreneurial way.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Oral exam from lecture part. Final project summary of designed algorithms.

## Programme content

1) Introduction to optimization
- aim function
- optimal solution
- local extrema
- necessary and sufficient conditions for optimal solution
2) One-dimensional optimization
- contraction method
- golden rate method
3) Gradient methods
- theoretical introduction
- gradient descent method
- steepest descent method
- conjugate gradient method
4) Non-gradient methods
- theoretical introduction
- Hook-Jeeves method
- Rosenbrock method
- Nelder-Mead method
- Gauss-Seidel method

## Course topics

none

## Teaching methods

Lecture: traditional form given on the blackboard with discussion
Lab classes: creating and algorithms and solving numerically given problems

## Bibliography

Basic:
1. Metody numeryczne, Ewa Majchrzak, Bohdan Mochnacki, WPŚ, Gliwice 2004
2. Numerical Analysis, Richard Burden, Douglas Faires, Brooks/Cole, Boston 2011
3. Introduction do optimization, Pablo Pedregal, Springer, New York 2004
4. An introduction to optimization, Edwin Chong, Stanislaw Zak, Wiley-Interscience, New Jersey 2008
5. Analiza numeryczna, David Kincaid, Ward Cheney, WNT, Warszawa 2006
6. Metody obliczeniowe optymalizacji, Władysław Findeisen, Jacek Szymanowski, Andrzej Wierzbicki, WPW, Warszawa 1972

Additional:
1. Podstawy optymalizacji statycznej, Przemysław Berowski, WKIE, Warszawaw 2008
2. Optimization in practice with Matlab, Achille Messac, Cambridge University Press, New York 2015

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 102 | 4,00 |
| Classes requiring direct contact with the teacher | 62 | 2,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 40 | 1,50 |