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•	Study outcomes and reference to the educational results for a field of study							
Knowledge:	Know	ledge:						
1. Having the necessary theoretical knowledge to optimize the structure to the level necessary for the field study [K_W18, K_W08]								
2. Knowledge of the basic concepts and procedures necessary for the optimal design [K_W18]								
3. Paying attention to the importance of optimization in the design process of technical devices, systems as well as in the area of professional and personal activities [K_W19]								
<ol> <li>Knowledge of the development trends of new procedures and methods of computation used in the practical design process [K_W17]</li> </ol>								
b. Understanding the systemic aspects of engineering activities, also in the area of optimal design [K_W19, K_W05] Skills:								

1. Ability to apply selected optimization procedures, the ability to apply optimization procedures contained in packages of mathematical programs. - [K\_U01]

2. Finding the optimal solutions for simple technical systems. - [K\_U04, K\_U07, K\_U08]

3. Understanding the importance of a systemic approach to the optimization problem. - [K\_U13, K\_U15, K\_U25]

4. Ability to use methods found in nature to solving complex technical problems - [K\_U01]

#### Social competencies:

1. Understanding the need for self-study related to development of technology. - [K\_K03]

2. Appreciation and understanding the systemic and social impact of engineering. - [K\_K06]

3. Understanding the importance of teamwork. - [K\_K01]

4. Ability to make appropriate decisions and understanding the consequences of these decisions for environment - [K\_K02, K\_K06]

# Assessment methods of study outcomes

Written exam.

Laboratory assessment ? project.

### **Course description**

Introduction to design of engineering systems (multidisciplinary, mechatronic design) using engineering examples and and examples from lessons from nature. Basics of optimal design of mechanical structures. Importance and meaning of optimization in design. Basic optimization concepts and terms (objective function, design variables, constraints). Classification of optimization problems. Methods of scalar optimization without constraints and with constraints with penalty functions. Genetic algorithms as the example of applying the lessons from nature. Mathematic fundaments of multicriteria optimization. Introduction to the Pareto concept of optimality. Survey of the modern optimization procedures. Selection of the efficient optimization procedures for practical engineering problems.

Application during laboratory classes of selected optimization procedures (search minimum of function in the direction, solving of unconstrained and constraints optimization problems) using MATLAB Optimization Toolbox.

### Basic bibliography:

1. Ostwald M.: Optymalizacja konstrukcji. Wydawnictwo Politechniki Poznańskiej, Poznań 2005.

2. Ostanin A.: Metody optymalizacji z MATLAB. Ćwiczenia laboratoryjne. Nakom Poznań.

### Additional bibliography:

1. Eschenauer H., Koski J., Osyczka A., Multicriteria design optimization, procedures and applications. Springer-Verlag, Berlin 1990.

2. Kirsch U., Structural optimization - fundamentals and applications. Springer-Verlag, 1993.

3. Rao S. S., Engineering optimization - theory and practice. John Wiley and Sons, 1996.

# Result of average student's workload

Activity	Time (working hours)
1. Participation in lecture.	15
2. Participation in laboratory.	15
3. Preparation for classes in the laboratory.	15
4. Preparation of the final project.	20
5. Consultations.	15
6. Preparation for the exam.	20

# Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	45	2
Practical activities	55	2