



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Fundamentals of optimal design [S1ETI2>POP]

Course

Field of study

Education in Technology and Informatics

Year/Semester

2/3

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

15

Laboratory classes

15

Other

0

Tutorials

0

Projects/seminars

0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of mathematics and other areas in the field of study. Ordered theoretical knowledge in the field of study. Ability to solve mathematical problems in the field of study. Capability to search for necessary information in literature, databases, the Internet, and in the given sources. Ability to self-study and self-education. Ability to use information and communication techniques relevant to the implementation of engineering tasks. Understanding the need to learn and expand their knowledge throughout their lives. Understanding the nontechnical aspects and effects of engineering activities. Willingness to cooperate in a team.

Course objective

Presentation in a concise and intelligible form basis for the optimum design of constructions, as well as other equipment and technical systems. Presentation of the basic concepts of optimal design and discussion of basic optimization procedures. Overview of the basics of multi-criteria optimization. Presentation of modern optimization procedures using a "nature lesson". Acquiring the ability to find optimal solutions for simple technical systems.

Course-related learning outcomes

Knowledge:

1. Knowledge of the basic concepts of optimization theory.
2. Knowledge of existing computational procedures necessary for optimal design.
3. Theoretical knowledge of structure optimization to the extent necessary for the field of study.
4. Knowledge of development trends, new procedures, and calculation methods used in practical design processes.

Skills:

1. Ability to build optimization models for technical systems.
2. The ability to use acquired mathematical knowledge to build mathematical models of real technical systems.
3. The ability to obtain information from literature, databases, etc. that is necessary to build mathematical models and optimization of technical problems.
4. Ability to use selected optimization procedures included in mathematical packages.
5. Finding optimal solutions for simple technical systems.
6. Ability to evaluate various design variants and identify optimal solutions taking into account many different criteria.

Social competences:

1. Understanding the need for self-study associated with the development of technology.
2. Appreciating and understanding the social and systemic effects of engineering activities.
3. Understanding the importance of teamwork.
4. Conduct in accordance with the principles of professional ethics.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: assessment based on a written test.

Evaluation criteria:

3.0 - 50,1%-60,0%

3.5 - 60,1%-70,0%

4.0 - 70,1%-80,0%

4.5 - 80,1%-90,0%

5.0 - 90,1%-100,0%.

Project: assessment based on a completed project.

Programme content

The subject is the optimal design of engineering structures. The lecture focusses on parametric, continuous, single, and multicriteria optimisation.

Course topics

1. Basic concepts of optimization theory: criterion function, decision variables, limiting conditions, etc.
2. Moving from the real problem (object, structure) to its optimization model.
3. Optimization of functions of one variable: analytical and numerical methods.
4. Nonlinear programming: the problem of minimizing functions without constraints. Theoretical foundations (necessary and sufficient conditions for the existence of an extremum of a function). Optimization procedures.
5. Nonlinear programming: the problem of minimizing functions with constraints. Theoretical foundations (necessary and sufficient conditions for the existence of an extreme). Numerical methods to find the minimum of a function (methods with a penalty function).
6. Multicriteria optimization: theoretical foundations and discussion of optimization procedures.

Teaching methods

Live lecture with multimedia illustrations supported by explanations on the blackboard.

Project - individual student project work, discussion.

Bibliography

Basic:

[1] Ostwald M., Podstawy optymalizacji konstrukcji w projektowaniu systemowym, Wydawnictwo Politechniki Poznańskiej, wydanie I, 2016.

[2] Stachurski A., Wierzbicki A. P., Podstawy optymalizacji, Oficyna Wydawnicza Politechniki Warszawskiej, 2001.

Additional:

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

[2] Rao S. S., Engineering optimization - theory and practice, John Wiley and Sons, 1996.

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00