POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name

STRUCTURAL OPTIMIZATION (SIZE, SHAPE AND TOPOLOGY)

Course

Proposed by Discipline
Mechanical Engineering

Year/Semester
II/3

Type of studies
Doctoral School

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
4

Tutorials

Projects/seminars

Number of credit points

1

Lecturers

Responsible for the course/lecturer:

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Faculty of Mechanical Engineering

Poznan University of Technology

ul. Jana Pawła II 24, 60-965 Poznan, Poland

Responsible for the course/lecturer:

Prerequisites

Knowledge: knowledge of methods of geometry modelling in CAD systems, basic knowledge of the construction of computer systems, basic knowledge in the field of structural analysis.

Skills: ability to use computer systems, the CAD system in the basic scope, model geometry in a CAD system and use finite element method in practice.

Social competencies: ability to work in a team, understanding the need to learn and acquire new knowledge.

Course objective

Transfer of knowledge about methods and processes related to advanced virtual design using CAD design systems. Indication of the role of structural optimization in the design process. Practical familiarizing students with modern possibilities of optimization of size, shape and topology. To acquaint students with available software for structural optimization.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:

1) the general knowledge covering the issues of structural optimization, [P8S_WG/SzD_W01]

2) of development trends in virtual design, especially structural optimization procedures in CAD systems. [P8S_WG/SzD_W01]

Skills

A PhD student who graduated from doctoral school can:

1) characterize the goals of structural optimization, [P8S_UW/SzD_U01]

2) characterize the types of structural optimization, [P8S_UW/SzD_U02]

3) apply practical structural optimization algorithms in the CAD environment. [P8S_UW/SzD_U02]

Social competences

A PhD student who graduated from doctoral school is ready to:

1) describe the algorithms and available software in the field of structural optimization. [P8S_KK/SzD_K01]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01	Short answer questions (concerning the area of structural optimization).	Test for: - level of knowledge, - application of knowledge, - potential problem-solving skills.
U01, U02	Short answer questions (concerning the area of structural optimization).	Test for: - level of knowledge, - application of knowledge, - potential problem-

		solving skills.
K01	Short answer questions (concerning the area of structural optimization).	Test for: - level of knowledge, - application of knowledge, - potential problem-solving skills.

Programme content

1. Introduction to the problem of structural optimization, review of software for structural optimization (introduction to the problem of structural optimization, parameterization of geometric models, the finite element method and its role in structural optimization procedures, size and shape optimization - basics, topology optimization – basics).

2. The essence and theoretical basis of structural optimization, practical application of structural optimization methods (configuration of a size optimization task, configuration of a shape optimization task, configuration of a topology optimization task, interpretation of the results of topology optimization, biomimetic structural optimization methods).

Teaching methods

Lecture: multimedia presentation including illustrations and examples.

Bibliography

Basic

1. Bendsoe M.P., Sigmund O., Topology optimization, Theory, Methods and Applications, Springer-Verlag, Berlin, Heidelberg, 2003.

2. Haftka, R., Gürdal, Z., Elements of structural optimization, 3rd edition, Kluwer, 1992.

3. Kirsch U., Optimum Structural Design, McGraw-Hill, New York, 1981.

4. Brandt, A., et al., Criteria and Methods of Structural Optimization, Springer, 1984.

5. Lewiński T., et al, Michell Structures, Springer, 2019.

Additional

1. Krog L., Tucker A., Kemp M., Boyd R., Topology optimization of aircraft wing box ribs, AIAA-Paper 2004, 4481, 2004.

2. Nowak M., Sokołowski J., Żochowski A., Justification of a certain algorithm for shape optimization in 3D elasticity, Structural and Multidisciplinary Optimization, Volume 57, Issue 2, pp. 721–734, 2018.

Breakdown of average student's workload

	Hours	ECTS
Total workload	29	1,0
Classes requiring direct contact with the teacher	4	0,5
Student's own work (literature studies, preparation for tutorials, project preparation) [1]	25	0,5

[1] delete or add other activities as appropriate