POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Industrial design [S2MiBM2>WP]

Course

Field of study
Mechanical 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
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge of geometry modeling methods in CAD systems. Basic knowledge of computer system design. Basic knowledge of structural analysis. SKILLS: Skill in operating computer systems. Ability to use CAD system to a basic extent. Ability to model geometry in a CAD system. Ability to 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

Subject carried out in cooperation with the University of Arts in Poznan - Faculty of Architecture and Design, Department of Design. An obligatory course in the curriculum, programmatically built to develop a platform for cooperation between future design engineers and designers. Course description: To impart knowledge of the methods and processes involved in advanced virtual design using CAD design systems. To develop practical skills in creating a virtual design. To indicate the role of structural optimization in the design process. To indicate the factors stimulating the market need for the development of such design methods, which is the increasing manufacturing potential of additive methods. With the mastery of the possibility of additive manufacturing of products directly in metal, the demand for a design process that breaks with traditional technological limitations has increased by leaps and bounds. Discuss the main issues of the relationship between the two disparate disciplines and identify the necessary field of potential cooperation - within the framework of defining design tasks during the process of creating a new product design. Discussion of examples of such cooperation based on the analysis of existing cases. Presentation of various forms of design notation and their potential possibilities and limitations, affecting the formation of the object form. Discussion of the impact of the issue of the relationship of the formation of the product form with the issue of basic differentiators taking into account market segmentation and audience differentiation and their identification.

Course-related learning outcomes

Knowledge:

1.The student knows and understands the relationship between the concept of a design solution and its implementation in terms of basic technologies.

2.The student knows and understands the basic materials, tools and methods used in the creation of a design project.

3.The student knows and understands basic digital imaging techniques related to the realization and documentation of design work, as well as 3D design methods and tools and digital techniques to support design.

4. The student has basic knowledge in the area of engineering design and engineering graphics to design objects and processes, systems in a systemic approach, formulate and analyze problems.

5. The student has basic knowledge of the area of structural analysis, is able to search for solution concepts; apply engineering calculations, select and evaluate solution alternatives; apply structural optimization methods.

6. The student has basic knowledge of development trends of computer-aided engineering design, knows selected numerical methods, and development trends of Cax systems.

7. Knows and understands the basic concepts and principles of economic, legal, ethical and other non-technical conditions of various types of professional activity related to the field of Mechanics and Machine Construction, including the principles of protection of industrial property and copyright.

Skills:

1 The student is able to use specialized computer programs to support the design process, make a choice of the appropriate technique of communication and implementation of the design task.

2.The student is able to communicate using terminology, related to design activities.

3.The student is able to follow the continuous development of design message techniques and practice the ability to use them in the process of continuous self-development.

4.The student is able to use information and communication techniques appropriate to the performance of tasks typical of engineering activities.

5.The student is able to conduct computer simulations, interpret the obtained results and draw conclusions. He/she is able to use computer support to solve technical tasks, especially in the area of structural optimization.

6. The student is able to obtain information from literature, databases and other appropriately selected sources; in particular, he/she is able to describe issues of biology and connect them with technical issues and engineering design, he/she is able to integrate obtained information, interpret it, and find similarities of developed methods in the field of engineering and achievements of Nature.

7. Is able to take into account social, economic, legal, ecological and other non-technical conditions in solving engineering problems.

Social competences:

1 The student is able to interact and work in a group.

2. The student is ready to exchange experience and information, flexible in his beliefs, thinking and

implementation decisions, which he adapts to changing conditions and circumstances.
3 The student is able to set priorities for the realization of a task defined by himself or others, especially in the area of structural analysis.
4. Able to think and act in a creative and enterprising way.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Verification test:
- the level of knowledge regarding elasticity theory,
- the level of knowledge concerning methods of structural analysis,
- level of knowledge regarding methods of structural optimization of structures,
- level of knowledge regarding industrial design methods and tools.

Questions with short answers (concerning the area of virtual design of structures) in the scope of the course material.
Verification test:
- ability to apply knowledge,
- practical skills of working with CAD/CAM systems .

Questions with short answers (concerning the area of virtual design of structures) in the scope of the course material.
Practical tasks.
Verification test:
- potential problem-solving skills.

Questions with short answers (concerning the area of virtual structural design) in the scope of the course material.
Grading criteria:
grade of very good (5.0) - the student's attendance in class and a very good pass on the final exam;
grade plus good (4.5) - student's attendance in class and good results of the final exam;
grade good (4.0) - student's attendance in class, satisfactory results of the final exam;
grade plus sufficient (3.5) - student's attendance in class and average level of passing the final exam;
grade sufficient (3.0) - student's attendance in class and low level of passing the final exam;
grade of insufficient (2.0) - the student's absence from 20% of classes or an insufficient level of passing the final exam.
Grades: very good - if the ratio of sums of achieved and total points is bigger than 90,1%; good plus - if the ratio of sums of achieved and total points is between 80,1-90%; good - if the ratio of sums of achieved and total points is between 70,1-80%; satisfactory plus - if the ratio of sums of achieved and total points is between 60,1-70%; satisfactory - if the ratio of sums of achieved and total points is between 50,1-60%; if the sum is smaller than 50% - unsatisfactory.

Programme content

Innovative program as part of the knowledge transfer between the Magdalena Abakanowicz University of Arts in Poznań and the Poznań University of Technology. A course in the study program, built programmatically to develop a platform for cooperation between future engineers and design designers.
The sample program is divided into: theoretical part, a series of lectures - design in the field of industrial design practical part, where students of both universities jointly developed projects according to the topic: "CONNECTIONS in functional objects"
The importance of connections that bind elements together. The connection should be integrated with the shape of the module. Enable solid connection of elements.
Perception of the form of a single module - a module as a single element can function independently, be visually interesting and fulfill its functionality.
Perception of its multiplication - duplicating its form creates a pattern, the module becomes part of the whole, the boundary between modules and connections is lost.
Stages:
1. Analysis of the topic, solutions, possibilities. Selection of the pot size.
2. Moodboard.
3. Ideas.
4. Concept.
5. Refining the project. UAP / PP data exchange
6. Development of 3D solids.

7. Creation of visualization.
8. Preparation of presentation and printing of the board presenting the project.
9. Creation of the final model using the digital printing method.

Course topics

Lecture topics:
1. The essence of virtual design using CAD systems.
2. Introduction to the issue of structural optimization.
3. Factors stimulating the market need for the development of modern design methods.
4. Additive manufacturing methods and their relation to virtual design methods.
5. The relationship of two distinct disciplines - mechanical design and industrial design - defining the necessary field of cooperation.
6. Forms of design notation and their influence on the formation of the object form.
7. Summary and review of specialized software.
Practical classes - computer laboratory Poznań University of Technology - relevant topics in design - design studio of the University of Arts in Poznań:
1. Geometric model as a basis for defining the field of cooperation between engineer and industrial designer.
2. The finite element method and its specificity in the case of optimization procedures - structural analysis as a basic design tool.
3. Design based on the strength propertis of the material - the practice of form search in the field of design.
4. Structural optimization - Nature's invention - biomimetics in design and its use in design.
5. Iindustrial design - the forms - design and design documentation.
6. Product form and its relationship to market segmentation, audience differentiation and ways to identify needs.
7. Final test.

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. Brandt A. M., Kryteria i metody optymalizacji konstrukcji, P WN, Warszawa , 1977.
3. Brandt A. M., Podstawy optymalizacji elementów konstrukcji budowlanych, PWN, Warszawa 1977
4. Chlebus E., Techniki komputerowe CAx w inżynierii produkcji, WNT, 2000
5. Laura Slack “Co to jest wzornictwo”, RotoVision 2006
6. Edward Hall-„Ukryty wymiar” Wydawnictwo Państwowy Instytut Wydawniczy (PIW), 1978
7. Alvin Toffler „Trzecia fala” Wydawnictwo Państwowy Instytut Wydawniczy (PIW), 1985
8. G. Allaire: Shape Optimization by the Homogenization Method, Springer, 2002, doi: 10.1007/978-1-4684-9286-6
9. Nowak M.: Projektowanie konstrukcji o wysokiej sztywności z zastosowaniem optymalizacji strukturalnej, Wydawnictwo Politechniki Poznańskiej , ISBN 978-83-7775-460-3, 2017

Additional:
1. Christiansen P.W., Clabring A., An Introduction to Structural Optimization (Solid Mechanics and Its Applications, ISBN1402086652, Springer, 2008
2. Krog L., Tucker A., Kemp M., Boyd R., Topology optimization of aircraft wing box ribs, AIAA-Paper 2004-4481, 2004
3. John Thackara “In The Bubble” /Designing in a Complex World, Publisher: The MIT Press, ISBN V, 2006
4. Daniel H. Pink „A whole new mind“, Riverhead Books, ISBN 9781594481710, 2006

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00