COURSE DESCRIPTION CARD - SYLLABUS

Course name
Human oriented design [S1IBio1>PZnC_1]

Course

Field of study
Biomedical Engineering

Year/Semester
3/6

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
0

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student starting the course has a basic knowledge of subjects such as Fundamentals of Machine Design, Mechanics, Technical Drawing and Computer Graphics. The student should have the ability to obtain information from the indicated sources and be ready to cooperate as part of the team

Course objective

The aim of the course is to combine the previously known methods of designing and constructing technical devices with the results of experimental research. The course introduces students to the methods of designing anthropotechnical systems in accordance with the philosophy of Human-centered design (human-oriented design).

Course-related learning outcomes

Knowledge:
Has basic knowledge of engineering design and engineering graphics, allowing to design objects and processes, systems in terms of systems, machine elements; formulate and analyze problems; look for solution concepts; apply engineering calculations, select and evaluate solution variants; use modeling, optimization and knowledge bases in engineering design, computer-aided design process, technical

drawing; read drawings and diagrams of machines, devices and technical systems; describe their structure and principles of operation. - [K_W05 (P6S_WG)]. Has basic knowledge of engineering design and engineering graphics, allowing to describe and apply the processes and systems of operation, reliability and safety, elements of technical diagnostics of machines related to the operational properties of materials; use the basics of computer-aided design of CAD in connection with computer-aided material design CAMS and technological CAM - [K_W06 (P6S_WG)]. Has a basic knowledge of the development trends of computer-aided engineering design, thanks to which he can describe and present the methods of recording the structure, rules of mapping and dimensioning, projection, simplification in the notation of the geometric form and dimension system, read assembly drawings, finite element methods (FEM) and boundary (MEB), selected numerical optimization methods, the use of FEM and MEB in computer aided design, the use of computer graphics in the process of creating technical documentation, CAD / CAM systems [K_W20 (P6S_WG)]. He knows the basic methods of techniques and tools in the field of engineering biomechanics, thanks to which he can describe the structure and mechanical and physical properties of human osteoarticular structures, factors and parameters of body posture, the basis of the strength of tissue materials - biomechanical aspects of overloading tissue structures, structure and biomechanics of the spine; is able to present the stabilizers used in the treatment of spine diseases, selected issues of the anatomy and biomechanics of the hip joint, the structure and elements of the anatomy of the knee joint, studies of stresses and deformations in the knee and hip joints; has knowledge of hip and knee arthroplasty, external stabilization of long bones; can characterize the construction of external stabilizers, the construction of selected stabilizers, the structure and biomechanics of the temporomandibular joint, selected issues of tribology of joints, experimental methods of biomechanics [K_W26 (P6S_WG)].

Skills:
Can obtain information from literature, databases and other properly selected sources (also in English or another foreign language recognized as the language of international communication) from biomedical engineering; in particular, can describe the issues of biochemistry and biophysics and combine them with technical issues and engineering design, can integrate the obtained information, interpret it, as well as draw conclusions and formulate and justify opinions [K_U01 (P6S_UW)]. Can use information and communication techniques appropriate to the implementation of tasks typical for engineering activities [K_U07 (P6S_UW)]. Can formulate and solve engineering tasks to use analytical, simulation and experimental methods. Can formulate problems and use mathematical methods and the laws of physics in the analysis of technical issues; can explain the role of chemical changes in industrial processes [K_U10 (P6S_UW)]. Can evaluate the usefulness of routine methods and tools for solving a simple practical engineering task, characteristic for biomedical engineering, and can select and apply the appropriate method and tools. [K_U18 (P6S_UW)].

Social competences:
Understands the need for lifelong learning; can inspire and organize the learning process of other people [K_K01 (P6S_KK)]. Is aware of the social role of a technical university graduate and understands the need to formulate and convey to the society, in particular through the mass media, information and opinions on the achievements of technology and other aspects of engineering activities; makes efforts to provide such information and opinions in a commonly understandable manner [K_K07 (P6S_KK)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written completion of tasks and questions from the program content. Project: A project task carried out in groups
passing threshold: 60%

Programme content

Lecture:
Lecture 1 - Introduction to human-oriented design. The lecture will discuss the basic aspects of the HCD method in machine design. The basic principles and examples of anthropotechnical constructions in accordance with the HCD method will be presented
Lecture 2 - Application application of integrated design to humans. The lecture will present real design problems and ways of solving them in accordance with the principles of HCD.
Lecture3 - Multi-criteria assessment in the process of developing design solutions. Discussion of the

methods of using the morphological matrix to build a set of design solutions. Presentation of the principles used in the multi-criteria assessment.
Lecture 4 - The use of anthropometric data in design. The lecture explains the basics of anthropometry, the percentile classification of dimensions and methods of measuring the human body.
Lecture 5 - Application of anthropometric dimensions in the design of technical devices. The lecture will present the methods of using anthropometric dimensions in designing types of mechanical structures. The basics of designing series of types will be discussed.
Lecture 6 - Modular structures. The lecture will discuss the principles of designing modular structures. On the basis of this information, the ways of using modular structures oriented to human needs will be presented.
Lecture 7 - Basics of interface design. The lecture will discuss the principles of designing interfaces taking into account the user's needs.
Lecture 8 - Methods of analyzing user needs. The lecture will discuss the methods of user needs analysis, the effect of which will be the correct formulation of the design task.
Projects:
Project 1 - Distribution of project tasks. During the classes, students will be given design tasks consisting of human needs that can be solved by means of a technical device. on this basis, students will formulate design tasks.
Project 2 - Formulation of the morphological matrix. During the class, students who know the design task will formulate a list of wishes and requests on the basis of which they will formulate a morphological matrix of various concepts of construction. The essence of the course is creative solving of an engineering problem by developing various variants and concepts of structures solving the assumed design task.
Project 3 - Formulation of the morphological matrix. During the class, students who know the design task will formulate a list of wishes and requests on the basis of which they will formulate a morphological matrix of various concepts of construction. The essence of the course is creative solving of an engineering problem by developing various variants and concepts of structures solving the assumed design task.
Project 4 - Multi-criteria assessment. During the classes, students will carry out a multi-criteria assessment of the construction concepts they have developed. During the course, they will develop evaluation criteria and assign them appropriate weights.
Project 5 - Preliminary construction concept, part 1. In class, students will use CAD software to create a conceptual model of their technical solution.
Project 6 - Preliminary construction concept, part 2. In class, students will use CAD software to create a conceptual model of their technical solution.
Project 7 - The use of anthropometric dimensions in the selection of design features. During the classes, students will use anthropometric atlases to verify the concepts they have developed. The aim of the course is to use anthropometric dimensions in the process of selecting regulatory systems.
Project 8 - Consultation classes. During the classes, students will present their solutions which will be discussed by the whole group. The aim of the course is to introduce feedback to the design process. This will allow the student carrying out the project to obtain the opinion of potential users and, on this basis, to modify his structure.

Course topics

The course covers topics in human-centered design (HCD), focusing on its application in machine engineering. In the first module, students are introduced to the fundamental principles and examples of anthropotechnical designs that follow HCD methodology, as well as real-world design challenges and ways to address them using HCD principles.

The next section focuses on multi-criteria evaluation of design solutions. Students learn methods for using the morphological matrix to analyze various design concepts and the principles applied in multi-criteria assessments. The course then delves into anthropometry, covering basic concepts, percentile classification of body measurements, and methods for measuring human body dimensions. This knowledge is applied by students in the design of technical devices, creating series of mechanical designs based on anthropometric dimensions.

In subsequent lectures, students explore modular constructions and design principles oriented toward human needs. They also study user interface design principles that take user requirements into account. This is complemented by a lecture on methods for analyzing user needs, enabling the correct formulation

of design tasks.

The project component of the course guides students through the entire conceptual design process. Initially, students are assigned project tasks in which they identify human needs that could be met by a technical device, forming the basis for their design objectives. In the next stage, they create a list of requirements and preferences, then develop a morphological matrix that facilitates creative problem-solving by allowing for various design concepts and configurations.

Students then continue developing their design concepts by formulating a rotation matrix, followed by a multi-criteria evaluation of their ideas, where they establish assessment criteria and assign appropriate weights. Using CAD software, they create preliminary conceptual models of their technical solutions, which are subsequently verified anthropometrically using measurement atlases. This verification process aims to ensure that the regulatory systems they design align with the anthropometric dimensions of users.

The practical sessions culminate in a consultation session where students present their designs to the group. During this stage, they receive feedback and suggestions from potential users and peers, enabling them to make modifications and refine their projects—an element of feedback integration essential to the design process.

Teaching methods

Lecture: multimedia presentation, illustrated with examples given on the board
Project: consultation with students on the project task being carried out

Bibliography

Basic:
Kamzol, A. Projektowanie zorientowane na człowieka (Human Centred Design) w planowaniu przestrzennym. Przestrzeń miejska jako przedmiot badań w geografii społeczńo-ekońomiczńej i gospodarce przestrzeńńej, 59.
Cichocki, P. (2001). Metodyka przechowywania wiedzy projektowej w budowie maszyn (Doctoral dissertation, Institute of Machine Design Fundamentals).
Branowski, B. K. (1999). Metody twórczego rozwiązywania problemów inżynierskich. Wydaw. Wielkopolska Korporacja Techniczna NOT.

Additional:
Cooley, M. (1999). Human-centered design. Information design, 59-81.
Boy, G. A. (Ed.). (2017). The handbook of human-machine interaction: a human-centered design approach. CRC Press.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	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)	20	1,00