COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced geometric modelling

Course

Field of study
Mechatronics
Area of study (specialization)
Mechatronic design of machines and vehicles
Level of study
Second-cycle studies
Form of study
full-time

Year/Semester
2/3
Profile of study
general academic
Course offered in
English
Requirements
elective

Number of hours

Lecture
15
Laboratory classes
Other (e.g. online)
Tutorials
Projects/seminars
15

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
PhD Eng. Krzysztof Wałęsa

email: krzysztof.walesa@put.poznan.pl

tel. 61 665 2318

Faculty of Mechanical Engineering

Piotrowo 3 Street, 61-138 Poznań

Responsible for the course/lecturer:
PhD Eng. Maciej Berdychowski

email: maciej.berdychowski@put.poznan.pl

tel. 61 665 2053

Faculty of Mechanical Engineering

Piotrowo 3 Street, 61-138 Poznań

Prerequisites

A student starting this subject should have basic knowledge in the field of lump, surface and hybrid

modeling in CAD 3D systems, as well as knowledge in various technologies for making parts of machines from metal alloys and plastics. The student should also have the ability to obtain information from the indicated sources and show a desire to develop independently in the use of CAD tools.

Course objective

The purpose of the subject is to learn about various methodologies of advanced geometric modeling in the aspect of designing parts of machines and vehicles from metal alloys and plastics, performed with various technologies. An additional goal is to acquire the skills to perform solid and surface models with non -standard geometry using selected 3D systems, from a group of commercially used solutions, e.g. Autodesk Inventor, Solidworks, NX and Catia. The obtained skills will allow the expansion of horizons in the scope of conscious design of machine parts and Automotive products, using advanced geometric modeling techniques, and in particular to discern in the possibilities and how to define machine parts in selected systems enabling geometric modeling. In classes, special attention will be devoted to the technology of making designed parts of machines and vehicles, in the aspect of the correct use of geometric modeling methodology.

Course-related learning outcomes

Knowledge

1. The student has knowledge of computer structure analysis including advanced operations in the CAD environment, regarding 3D visualization and analysis of the cooperation of mechanical elements.

2. The student has an extended knowledge of mechatronics, knowledge of the analysis and design of complex mechatronic systems, systems theory and technology, and the application of modeling and simulation in mechatronic design.

3. The student has knowledge of industrial property protection, copyright, intellectual property management and is able to use patent property resources.

Skills

1. The student can visualize a mechanical element in a 3D environment and analyze the cooperation of elements shown in the drawing.

2.The student can design complex devices and mechatronic systems, using modeling and simulations. He can plan and conduct experiments, including computer measurements and simulations, interpret obtained results and draw conclusions.

3. The student can define the directions of further learning and implement the process of self-education.

Social competences

1. The student is able to set priorities for the implementation of the specified or other tasks.

2. The student understands the need for lifelong learning; He can inspire and organize the learning process of other people.

3. The student can think and act in a creative and entrepreneurial way.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: crediting a one- or multiple choice test.

Evaluation criteria

less than 50% inadequate

51%-60% sufficient

61%-70% sufficient plus

71%-80% good

81%-90% good plus

91%-100% very good.

Project classes: credit and evaluation based on the weighted average from partial grades obtained from two individual projects implemented during the semester. The projects will be assessed taking into account, among others: the implementation of the assumed purpose of the design task, the correctness of the geometric modeling methodology used in the CAD system and the technology of the designed part of the machine or vehicle.

Programme content

Lecture: The content of the lecture will include:

- the most important theoretical issues related to the preparation of geometric models in CAD systems,

- issues related to the technology of making individual parts of machines and vehicles, and consequently with the appropriate selection of the CAD tool to prepare the product geometric model,

- case study regarding the geometric modeling method of individual parts of machines and vehicles, presented by the lecturer.

Lecture 1: Introduction to the advance geometric modelling including: rules for preparing geometric models and their classification, types of CAD systems and working files management, as well as the asociety of prepared models. Boole's operations on lump models.

Lecture 2: Parametric modeling in the aspect: adaptability of prepared models and technologically similar parts.

Lecture 3: Topology of geometric models in the aspect of optimizing the geometric structure.

Lecture 4: Shaping products with a lump structure, performed using various machining technologies, work using advanced geometric modeling tools in the CAD system and taking into account the technological rules regarding the design of such parts of machines and vehicles.

Lecture 5: Modeling of curves for the design of the geometry of machine and vehicle parts.

Lecture 6: Surface modeling for the design of the geometry of machine and vehicle parts.

Lecture 7: Shaping of products with surface structure, performed using various machining technologies, work using advanced geometric modeling tools in the CAD system and taking into account the technological rules regarding the design of such parts of machines and vehicles.

Lecture 8: credit.

Design classes:

The scope of design classes will include independent preparation by students of 2 projects covering issues related to the geometric design of parts of machines and vehicles made of metal alloys and plastics, taking into account the technology of their implementation. Work on solutions will take place in design classes in consultation with the lecturer.

Project 1 (classes 1-3): Design of a machine part with a solid structure, taking into account the variantity of technology and the possibility of preparing a set of technologically similar parts, modifiable without the need to manually rebuild the geometric model.

Project 2 (classes 4-7): a design of a surface part performed on the basis of the aesthetic (reference) suface obtained from the lecturer with the assumption of specific cooperation points with other parts of the device or vehicle. Transformation of a surface design into a solid model, allowing the shape of the geometry of injection (or foundry) or planning 3D printing, while maintaining the principles characteristic of the given performance technology.

Classes 1: Implementation for solid design using a given CAD tool, presentation of advanced methods of shaping solid parts and machine assemblies.

Classes 2 and 3: Preparation of projects with technical documentation.

Classes 4 and 5: Implementation for surface design using a given CAD system. Familiarizing with advanced methods of shaping the surface of parts and teams of machinery.

Classes 6 and 7: Preparation of projects with the necessary technical documentation.

Classes 8: Presentation of work results, assessment.

Teaching methods

Lecture: Information lecture, Case Study - multimedia presentation, presentation of activities in the CAD system. Design classes: project method - presenting examples, work of students on allocated cases on computers in the laboratory, ongoing consultation of progress with the lecturer.

Bibliography

Basic

1. Branowski Bogdan, Wprowadzenie do projektowania, PWN, 1998.

2. Branowski Bogdan, Zagadnienia kontruowania maszyn z wykorzystaniem CAD, Wydawnictwo PP, 1994.

3. Branowski Bogdan, Metody twórczego rozwiązywania problemów inżynierskich, Wydawnictwo NOT, 1999.

4. Wełyczko Andrzej, CATIA V5. Sztuka modelowania powierzchniowego, Helion, 2010.

5. Wełyczko Andrzej, CATIA V5. Przykłady efektywnego zastosowania systemu w projektowaniu mechanicznym, Helion, 2005.

6. Stasiak Fabian, Zbiór ćwiczeń: Autodesk Inventor 2020 - kurs zaawanowany, EkspertBooks, 2020.

7. Jaskulski Andrzej, Autodesk Inventor Professional 2021PL/2021+/Fusion 360: metodyka projektowania, Helion, 2020.

8. Kęska Paweł, SolidWorks 2014: modelowanie powierzchniowe, narzędzia do form, rendering i wizualizacje: podręcznik do nauki na poziomie zaawansowanym, CAD Advantage, 2014.

9. Domański Jerzy, SolidWorks 2020: projektowanie maszyn i konstrukcji: praktyczne przykłady, Helion, 2020.

10. Mazur Damian, Rudy Marek, Modelowanie w systemie NX CAD, Oficyna Wydawnicza Politechniki Rzeszowskiej, 2016.

Additional

1. Chlebus Edward, Techniki komputerowe CAx w inżynierii produkcji, Wydawnictwa Naukowo-Techniczne, 2000.

2. Anupam Saxena, Birendra Sahay, Computer Aided Engineering Design, Springer 2005.

3. Kiciak P., Podstawy modelowania krzywych i powierzchni: zastosowania w grafice komputerowej, Warszawa, WNT 2000.

4. Krawiec Piotr (red.), Grafika komputerowa (wyd. VI rozszerzone) wyd. Politechniki Poznańskiej, 2020.

5. Wałęsa Krzysztof, Malujda Ireneusz, Talaśka Krzysztof, Wilczyński Dominik, Process analysis of the hot plate welding of drive belts, Acta Mechanica et Automatica, 14(2), 84-90.

6. Wałęsa Krzysztof, Malujda Ireneusz, Górecki Jan, Wilczyński Dominik, The temperature distribution during heating in hot plate welding process, MATEC Web of Conferences, 254, 02033.

7. Berdychowski Maciej, Malujda Ireneusz, Wałęsa Krzysztof, Fierek Aleksandra, Analysis of angular deflection of bearing node in machine with toothed transport belt, IOP Conference Series: Materials Science and Engineering, 776, 012019.

8. Berdychowski Maciej, Talaśka Krzysztof, Malujda Ireneusz, Kukla Mateusz, Application of the Mohr-Coulomb model for simulating the biomass compaction process, IOP Conference Series: Materials Science and Engineering, 776, 012066.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for credit, preparation for project classes, preparation of project). [1]	20	1,0

[1] delete or add other activities as appropriate