COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technical drawing and CAD [S1Mech2>RTiCAD2]

Course

Field of study
Mechatronics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
0

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Completion of introductory subjects such as Fundamentals of Mechanics, Machine Design, or other technical courses covering the analysis of engineering documentation. The student should have a basic knowledge of technical drawing, including the ability to read and interpret engineering drawings and assembly drawings, knowledge of projection principles and drawing standards (PN/ISO), determination of dimensional and geometric tolerances, as well as understanding technical markings such as roughness, fits, and threads. A basic understanding of the principles of creating engineering and assembly drawings in accordance with the guidelines of drawing standards PN-ISO 128 is also required. Additionally, knowledge of the fundamentals of descriptive geometry is necessary, including the ability to create geometric constructions used in technical drawing and topics such as tangents, body intersections, dividing segments, and drawing regular polygons. Proficiency in operating the Windows system and basic knowledge of file management is also essential.

Course objective

Development of skills in the preparation of technical documentation and computer modeling using AutoCAD and Autodesk Inventor software. Students gain practical competencies in drawing, dimensioning, and parameterizing technical drawings in accordance with PN/ISO standards, as well as designing 3D models and assemblies of mechanical components.

Course-related learning outcomes

Knowledge:
Has knowledge of the principles of technical drawing and the PN/ISO drawing standards applied in technical documentation.
Knows the functions and capabilities of AutoCAD and Autodesk Inventor software in the preparation of technical drawings and 3D models.
Understands project management principles in CAD software.
Has knowledge of the use of AutoCAD and Inventor in the documentation of mechatronic devices.
Understands the process of designing and modeling mechanical parts and assemblies using standardized component libraries.

Skills:
Can create digital technical documentation in accordance with technical requirements and drawing standards.
Is skilled in using advanced AutoCAD tools for editing, dimensioning, layer organization, and creating blocks.
Can utilize parametric tools to create 2D drawings and apply geometric and dimensional constraints.
Is capable of modeling parts and assemblies in Autodesk Inventor using solid modeling methods.
Can generate technical documentation based on 3D models, including executive drawings, sections, and material lists.
Can create documentation for basic electrical diagrams and control cabinet documentation.
Is able to prepare complete project documentation, taking into account engineering requirements and industry standards.

Social competences:
Understands the importance of precise and standards-compliant technical documentation in the design and production process.
Demonstrates readiness for teamwork in the creation and editing of technical documentation and engineering projects.
Is capable of independently solving technical problems related to CAD drawing and modeling.
Is aware of the need for continuous improvement of CAD design and technical documentation skills.
Demonstrates responsibility for the quality of work and ensures that documentation complies with applicable standards and regulations.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Laboratory classes: A practical task to be completed during class and at home, after which the student is required to prepare a report that is assessed for the accuracy of the tasks performed, compliance with drawing standards, and correct use of CAD tools. The report should include a description of the exercises completed, the methods used, and the 2D drawings or 3D models created during the classes.
Laboratory grading criteria:
5.0 (Excellent) - complete reports, executed according to standards and requirements, the student demonstrates full understanding of the topic and applies advanced CAD software functions.
4.5 (Good Plus) - correct reports, containing all required elements, minor inaccuracies in technical details.
4.0 (Good) - correct reports, but may contain small mistakes in drawing execution or CAD tool usage.
3.5 (Satisfactory Plus) - reports contain errors in dimensioning, technical markings, or incomplete use of CAD tools.
3.0 (Satisfactory) - incomplete reports with significant errors, but the student demonstrates basic knowledge of the topics.
2.0 (Unsatisfactory) - lack of reports or significant errors preventing grading.
Project classes: Evaluation of the final project, which includes technical documentation consisting of

assembly drawings, execution drawings, and 3D models of selected components. Verification of the correctness of applied drawing standards, dimensioning, and layer organization and file structure. Evaluation of the accuracy of the representation of the design and the quality of 3D models and assemblies.
Project grading criteria:
5.0 (Excellent) - complete project, executed according to standards, with full technical documentation and correct use of CAD tools, the student demonstrates creativity and advanced software knowledge.
4.5 (Good Plus) - correct project, with minor errors in documentation, good use of CAD functions, but optimization of some solutions is possible.
4.0 (Good) - project meets requirements but contains minor shortcomings in dimensioning or layer structure and project organization.
3.5 (Satisfactory Plus) - the technical documentation is complete but contains significant errors in dimensioning or technical markings.
3.0 (Satisfactory) - incomplete project or one containing major errors, but demonstrating basic knowledge of CAD tools.
2.0 (Unsatisfactory) - project does not meet requirements, lacks significant elements of technical documentation, or contains glaring errors in drawings and models.

Programme content

Laboratory classes: The course covers the practical application of AutoCAD software for the creation of technical documentation and 2D modeling. Students will become familiar with the basic tools for drawing and editing objects, such as lines, polylines, circles, arcs, arrays, scales, copying, moving, rotating, and geometry editing tools. The principles of working with layers, setting object properties (color, line thickness, line type), and organizing the drawing structure will be discussed. Students will learn to use tools for dimensioning, applying dimensional and geometric tolerances, and utilizing technical descriptions in compliance with PN/ISO standards. Additionally, features related to AutoCAD Mechanical, which enable the generation of machine parts such as shafts, gears, and bearings, will be introduced. Students will also learn about AutoCAD Electrical tools used for designing electrical diagrams and control systems.
Project classes: During project classes, students will develop complete technical documentation, including executive drawings, assembly drawings, and 3D models of selected components. The AutoCAD Mechanical tools will be used to create drawing templates, generate frames, drawing tables, as well as mark roughness, fits, and tolerances. In the 3D modeling part, students will work with Autodesk Inventor software, learning basic and advanced solid modeling methods. 2D and 3D sketching functions, geometric and dimensional constraints, operations on solids (extrude, revolve, fillet, chamfer), as well as modeling bent, thin-walled, and welded components will be covered. Students will also learn methods for creating mechanical assemblies and using standardized part libraries and machine part generators (shafts, gears, threaded connections). Additionally, methods for generating technical documentation, including creating executive drawings and assembly drawings, sections, exploded views, and bill of materials (BOM) will be discussed. At the end of the course, students will develop a final project that will be evaluated based on technical accuracy, compliance with standards, and the quality of the created documentation.

Course topics

Laboratories:
Introduction to AutoCAD and basic drawing tools - user interface, drawing organization, basic drawing and editing tools (lines, circles, polylines, offsets, copy, scale, array, mirror).
Layer management and object properties - working with layers, assigning colors, line types, and line thicknesses, managing object properties, using blocks and attributes.
Print Manager - working with the print manager, configuring PDF plotter, configuring print settings for technical documentation.
Fundamentals of orthographic projection - constructing views according to the principles of orthographic projection, arranging views on the drawing, exercises in reproducing simple solids using viewports.
Breaks, sections, and cuts in technical documentation - using tools for automatic hatching and marking cutting lines, applying advanced configuration methods to meet PN-ISO standards.
Dimensioning in AutoCAD - dimensioning tools, automatic placement of dimensions, dimensional and geometric tolerances using built-in generators.

Threaded connections and standardized parts generators - using AutoCAD Mechanical to generate threaded connections.
Shaft generator - reproducing a shaft and selected cooperating parts using the shaft generator in AutoCAD Mechanical.
AutoCAD Electrical - basics of designing electrical diagrams and control cabinets.
Modeling basic parts in Autodesk Inventor - 2D sketching, applying constraints, solid operations (extrude, revolve, fillet, chamfer).
Modeling sheet metal structures - designing the unfolding of a bent structure.
Modeling assemblies in Autodesk Inventor - assembling components, defining constraints, working with standardized parts.
Modeling welded assemblies - creating an assembly model using welded joints.
Creating executive and assembly drawings - generating 2D documentation from 3D models, sections, detailed views, material lists.
Projects:
Discussion of the project scope and design assumptions - introduction to the gear transmission project, distribution of project materials, analysis of requirements.
Preparation of drawing table and frame - creating and editing the drawing table, adjusting drawing formats according to PN-ISO standards.
Creating a real shaft model and its components - assembling the real shaft model using standardized elements (bearings, rings, gears).
Modeling the shaft in Autodesk Inventor - reproducing the real shaft model in the CAD environment, using the shaft generator.
Creating executive drawings for key transmission elements - technical documentation for the shaft, gears, and gearbox housing.
Modeling the gearbox assembly in Autodesk Inventor - adding components, defining constraints, reproducing the real structure.
Standard parts generator - adding components to the CAD model - inserting standardized parts into the gearbox based on the real model.
Developing the technical documentation of the project - generating assembly drawings, mounting drawings, material lists, and exploded views.
Project presentation and evaluation - discussing the work completed, analyzing the accuracy of technical documentation, summarizing the project results.

Teaching methods

Laboratory classes - conducted in the form of practical exercises at computer workstations using AutoCAD, AutoCAD Mechanical, AutoCAD Electrical, and Autodesk Inventor software. Students complete tasks following the instructor's guidelines, learning the functions of CAD programs and principles of technical drawing.
Project classes - independent execution of a gear transmission project, including the development of technical documentation, such as executive drawings, assembly drawings, and 3D models. The classes focus on analyzing the real model of a shaft and transmission and then reproducing it in the CAD environment.

Bibliography

Basic:
Dobrzański, T., & Różański, P. (2021). Rysunek techniczny maszynowy (in English: Technical Drawing of Machines). Wydawnictwo Naukowe PWN.
Romanowicz, P. (2021). Rysunek techniczny maszynowy z elementami CAD: opracowanie zgodne z normami na 2021 r., aktualne oznaczenia GPS, modelowanie CAD (in English: Technical Drawing of Machines with CAD Elements: A Guide Compliant with 2021 Standards, Current GPS Markings, and CAD Modeling). Wydawnictwo Naukowe PWN.
Kurmaz, L. W., & Kurmaz, O. L. (2011). Podstawy konstruowania węzłów i części maszyn: podręcznik konstruowania (in English: Fundamentals of Designing Machine Joints and Components: A Design Manual). Samodzielna Sekcja "Wydawnictwo Politechniki Świętokrzyskiej".

Additional:
Lewandowski, T. (1999). Rysunek techniczny dla mechaników: podręcznik dla technikum i szkoły zasadniczej (in English: Technical Drawing for Mechanics: A Manual for Technical and Vocational

Schools). Wydawnictwa Szkolne i Pedagogiczne.

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